UNIVERSITY OF EDUCATION, WINNEBA

STUDENTS' COMPETENCY IN THE USE OF COMPUTER ASSISTIVE TECHNOLOGY AT AKROPONG SCHOOL FOR THE BLIND

JOSEPH AMPRATWUM

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MAY, 2015

DECLARATION

CANDIDATE'S DECLARATION

I, Joseph Ampratwum, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Candidate's Name: Joseph Ampratwum

Signature..... Date.....

SUPERVISOR'S DECLARATION

I, hereby certify that the preparation and presentation of this thesis was supervised in accordance with guidelines and supervision of thesis laid down by the University of Education, Winneba.

Supervisor's Name: Dr Yaw Nyadu Offei

Signature..... Date.....

DED ICATION

I dedicate this work to the Late Dr. Mark Anthony Ocloo

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Acronyms

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M.T.N	Mobile Telecommunication Network ……...49
B.E.C.E	Basic Education Certificate Examination)…….47
S.I.P.P	Survey of Income and Programme Participation)……..3
N.T.I.A	National Telecommunication and Information Administration)……3
P.D.A	Personal Digital Assistant)…….15
O.C.R	Optical Character Recognition)…….20
P.T.A	Parents Teachers Association)……..46
J.A.W	Job Assess With Speech)……..26
G.E.S	Ghana Education Service……..47
SPSS	Statistical Package for Social Sciences……...44

ABSTRACT

The objective of the study was to assess students' competencies in the use of computer assistive technology at Akropong School for the Blind. This became necessary because little research has been conducted to document the competencies and challenges in the use of computer among students with visual impairments. A case study design with a mixed research strategy was adopted for the study. The researcher gathered both quantitative and qualitative data to measure the students' competencies in keyboarding skills and Job Access with Speech (JAWS), as well as the other challenges. The findings indicated that comparatively students' competency in keyboard skills was higher than JAWS application use. Thus students had reached higher stages in the conscious competencies matrix in the former than the latter. It was generally noted that challenges limiting effective use of students' competencies in computer assistive technology in the School were more personal than external influences. This was because most of the challenges were due to the individual response to the training and familiarity in developing their competencies in using computer assistive technology. Base on this it was recommended that efforts should be made to stock up the laboratory with additional computers. Directly in line with the first recommendation, it was further suggested that more practice time should be created for the students to maximize computer use. Also Licensed JAWS must be acquired by the school to advance students' competence in using computer assistive technology.

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

Assistive technology is a broad and inclusive term that includes both assistive technology devices and assistive technology services (Adapted computer assistive technologies 2004). An assistive technology device is any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with disabilities. Again, an assistive technology service means any service that directly assists a child with a disability in the selection, acquisition, or use of an assistive technology device. The term includes the evaluation of the needs, selecting, designing, fitting, customizing, adapting, applying, retaining, repairing, and technical assistance for a child with a disability, family members or, professionals (Sah, 2013).

Assistive technologies have helped persons with visual impairments to achieve better levels of independence through more access to information. The technology available for persons with visual impairment could be divided into three major categories: no-tech, low-tech, and high-tech (Smith, 2008). No-tech or, no-technology refers to any assistive device that does not consist of any electronic device within it. No-tech items include Braille slate, Taylor-Frame, abacus, reading stand, bold-lined paper, long cane etc. Low-tech or, low technology devices may be electronic but do not include highly sophisticated advanced components. This category includes electronic voice-recorder, audio player, a talking calculator, Braille, etc. High-tech or high

technology devices utilize complex, multifunction technology and usually include a computer and associated software.

While all technologies have impacted on the lives of individuals with visual impairments, the high-tech devices especially in the area of computer assistive technology have had the greatest impact on success in education and employment (Gamble & Hirsch 2003). The use of computer assistive technology has engaged the attention of students in Schools for the Blind. Children with visual impairments who are tactual learners have one unique need which is quite different from all other disability groups. They depend on computer assistive technology skills for learning to read and write (Gamble & Hirsch).

Computer assistive technology, one of the main assistive technology resource applied to educating visually impaired students, is a computer with programs that allow students to access the digital environment, promoting individual life, social and education inclusion (UNESCO, 1994). These computers include screen reader software that provides an aural translation of the information on the screen, voice recognition software, Job Access With Speech (JAWS), natural reader that allows people to navigate with voice rather than a keyboard or mouse, and many input devices such as keyboards and mouse pedals. Computer assistive technology allows individuals with visual impairment to overcome a major part of the difficulties in daily life and offers them independence and autonomy concerning information management and access to communication, just like their peers with normal vision (Caparros, 1994). A talking computer opens up a whole world of opportunities waiting to be tapped and exploited for persons with visual impairment. Using a word processor, one could easily take up a stenographer's job,

indulge in creative writing and put down one's thoughts in black or white, or run columns in newspapers. Students, teachers and researchers could maintain note with it. At the work place, data could be accessed using database and spreadsheet packages. Accounts could be kept track of using financial accounting packages. A talking computer could also be very useful for professionals like lawyers, consultants and the likes. Books, journals and others could be easily read using scanners and suitable software.

Despite the enormous benefits of computer assistive technology, it seems individuals with visual impairments (that is, those who are blind or have low vision) are much less likely to use computers than sighted individuals. This assertion is confirmed by the statistics from the U.S. Bureau of the Census's Survey of Income and Program Participation (Gerber & Kirchner,2001) which revealed that 21% of all non institutionalized individuals aged 15 and older with "functional limitations in seeing" have access to the Internet; only 13% of the same population reported using a computer on a regular basis (Gerber & Kirchner). The competence rates among the disabled and nondisabled population are 57% were 51%, respectively.

Computers, like all other assistive technologies, provide a rich and diverse bearing in the lives of students with visual impairments. They enable these students to access information and to complete tasks efficiently, thereby enabling them to achieve the highest level of independence possible. However, studies have shown that students do not fully benefit from the use of computer assistive technology in home, school and community settings. This is echoed with findings of students with visual impairments in the US. In one study, 60% of students with visual impairments were not benefitting from computer assistive technology (Kapperman & Sticken, 2002). In another study, the figure

was between 59% and 71% of students who were inclined to benefit from computer assistive technology but did not have the opportunity to use it (Kelly, 2009).

Individuals with visual impairment have for centuries relied upon assistive technology to access information, travel independently, and participate in a variety of experiences (Smith, 2008). They have a long history of the successful use of assistive technology dating back to ancient civilizations that used types of the long cane for independent travel (Smith & Kelley, 2007). The history of blindness shows how specifically embodied, individual practices and the relation with objects and technologies play a central role in articulating socialness and humanity (Schillmeier, 2008). Computer assistive technology could support wider group of students with visual impairment (including students who are blind or have low vision) in all academic areas as well as in expanded core curriculum (Wiazowski, 2009).

Students with visual impairment could attain the full benefits of computer assistive technology if they are equipped with the needed competencies and dispositions in the use of such devices. This would further enrich and transform their learning environment and also improve their quality of life. This study is significant as it appears to be the first study of its kind to investigate computer assistive technology use among students with visual impairments in Ghana.

1.2 Statement of the Problem

In a preliminary visit to the Akropong School for the Blind, the researcher observed that some students with visual impairments appear to exhibit some errors in keyboarding skills. This appears to be due to challenges in remembering keyboard

shortcuts, inability to have access to license speech software and difficulties with voice discrimination of Job Access With Speech (JAWS). It appears that there were also inadequate qualified personnel with regard to teaching computer assistive technology. Furthermore, it appears the competencies of persons with visual impairment students in the usage of computer assistive technology in the school was due to the lack of adequate computer to meet the needs of students who are blind.

Furthermore, it appears that the huge impact of technology has not facted when considering those with visual impairments impact in teaching and learning. Though many professionals in the field understand, at least anecdotally, that computer use could make a tremendous difference in the lives of students with visual impairments by improving their educational and employment opportunities, enhancing their social networks and facilitating their independence, yet, little research has been conducted to document the competencies and challenges to computer usage among students with visual impairments.

Such information or data is important for planning appropriate intervention for the optimum utilization of assistive technology thereby improving the quality of life in children with visual impairment. This research has, thus, been necessitated by the paucity of information regarding computer assistive technology use among school going children with visual impairment in Ghana.

1.2 Purpose of the study

The purpose of the study was to assess student's competencies in the use of computer assistive technology at Akropong School for the Blind in the Eastern Region of Ghana

1.3 Objectives

1. To assess students' competencies in the use of keyboard at Akropong School for the Blind.
2. To find out how students who are blind use Job Access With Speech (JAWS) to search for basic information from computer at Akropong School for the Blind.
3. To identify the challenges associated with computer assistive technology usage among students at Akropong School for the Blind.

1.4 Research Questions

1. How competent are students in the usage of keyboard at Akropong School for the Blind?
2. How competent are students who are blind in using Job Access With Speech (JAWS) in the search of basic information from the computer at Akropong School for the Blind?
3. What are the challenges associated with the use of computer assistive technology among students who are blind?

1.5 Significance of the Study

Findings from the study help in revealing the competencies of students in the usage of keyboard techniques. This would enable teachers to employ all the necessary strategies in assisting students to acquire or improve their skills in keyboarding. The result of the study would highlight the competence level of students in the use of Job Access With Speech (JAWS) in searching basic information from the computer. The

findings in this regard would help to evaluate the proficiency and skills of students in accessing basic information from the computer as well as their challenges to computer usage. In addition, the research findings would add to fill the existing literature for other researchers interested in similar studies.

1.6 Delimitations

Even though there are other Schools for the students who are blind, this study only focused on Akropong School for the Blind in the Eastern Region of Ghana, in the usage of keyboard, JAWS as well as the challenges associated with the use of the computer assistive technology.

1.7 Limitation

The researcher was unable to assess competencies among JHS 1and JHS 3 students. The JHS 1 students were excluded because the ICT teacher perceived they were yet not to gain adequate experience in computer assistive technology use as taught in the JHS curriculum. The JHS 3 students on the other were excluded because at the time of the data collection, they were preparing for the Basic Education and Certificate Examination.

Furthermore, some students were not coming forth on certain issues especially in relation to the objective on the challenges to computer assistive technology use. This affected the discussion on certain vital information and this indeed affected the depth of the research findings and the discussion drawn.

1.8 Organization of Study

The study was organized into six chapters. Chapter one covers the introduction which covers the problem statement; objectives; research questions; significance of the study; as well as the limitations and delimitations of the study. Chapter two reviews the scientific literature under specific themes. It also discusses the conceptual framework which serves as a guide towards data collection. Chapter three looks at the methodology; and highlights the study design, study population and sampling techniques and size. It also includes the techniques and tools of data collection, analysis and presentation as well as the ethical considerations.

Chapter four presents the findings of the study with regards to the specific objectives which are the types of assistive technology, students' competency, barriers to its use and patterns. Chapter five discusses the results as presented in the previous chapter in the light of the scientific literature. Chapter six outlines the conclusion, and recommendations which be made based on the summarized findings as well as arising issues for further research in this dimension.

1.9 Operational Definition of Terms

Computer: It is an electronic device that has been assembled as a system, for taking data (as input) for processing the data and acquiring information (as output) from the processed data which can be stored and retrieve for future use**.**

Computer Competency: Ability to demonstrate efficiency in computer use especially when measured against a standard. Student competency in Computer is the ability of the student to display a skill efficiently involved in computer use. This involves the

successful use of keyboard and effectively discriminate voices Job Access with Speech skillfully to yield the desired results. It also means the ability to demonstrate the skills, strategies involved in computer use.

Assistive technology: assistive technology is any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with disabilities**.**

Competency: the ability to demonstrate a skill efficiently when measured against standard.

Visual impairment: is an umbrella term use to describe those with low vision and those who are totally blind. Those with low vision have perception of light and those who are totally blind have no perception of light.

1.10 Summary of Chapter

This chapter presented the introduction to the entire study. In the background to the study, it focused in students with visual impairment on how they could attain the full benefits of computer assistive technology if they are equipped with the needed competencies and dispositions in the use of such device. Thus, this current research therefore lays a strong foundation for building scientific literature on the use of computer assistive technology among students with visual impairment in the Ghana context.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the literature review for the study. For effective presentation of review, the chapter is organized under these subthemes, such as: Theoretical framework, competencies of students in the usage of keyboard, the competencies of students in using Job Access With Speech, and challenges associated with the use of computer assistive technology among students, understanding the role of computer assistive technology and Assistive technology.

2.1Theoretical Framework for the study

The study adopted the Conscious Competence Learning Model by Martin Broad well 1970. The real originator of this model is unknown even though it is widely being used in research relating to measurement of competence. It is most commonly known as the 'conscious competence learning model', sometimes 'conscious competence ladder' or 'conscious competence matrix', although other descriptions are used. The conscious competence model explains the process and stages of learning a new skill (or behaviour, ability, techniques). It is a useful reminder of the need to learn and train others in stages. The Conscious Competence Learning Model often comes in four stages though occasionally a fifth stage or level is added in more recent adapted versions. The learner or trainee always begins at stage 1 – 'unconscious incompetence', and ends at stage 4 – 'unconscious competence', having passed through stage 2 – 'conscious incompetence' and - 3 'conscious competence'.

Teachers and trainers commonly assume trainees to be at stage 2, and focus efforts on achieving stage 3, when often trainees are still at stage 1**.** The trainer assumes that the trainee is aware of the skill existence, nature, relevance, deficiency, and benefit offered from the acquisition of the new skill. Whereas trainees at stage 1 - unconscious incompetence - have none of these things in place, and would not be able to address achieving conscious competence until they have become consciously and fully aware of their own incompetence.

If the awareness of skill and deficiency is low or non-existent – for an example, the learner is at the unconscious incompetence stage - the trainee or learner would simply not see the need for learning. It is essential to establish awareness of a weakness or training need (conscious incompetence) prior to attempting to impart or arrange training or skills necessary to move trainees from stage 2 to 3.

People only respond to training when they are aware of their own need for it, and the personal benefit they would derive from achieving it.

The progression is from quadrant 1 through 2 and 3 to 4. It is not possible to jump stages. For some skills, especially advanced ones, people could regress to previous stages, particularly from 4 to 3, or from 3 to 2, if they fail to practise and exercise their new skills. A person regressing from 4, back through 3, to 2, would need to develop again through 3 to achieve stage 4 - unconscious competence again. For certain skills in certain roles stage 3 conscious competence is perfectly adequate. Progression from stage to stage is often accompanied by a feeling of awakening - 'the penny drops' - things 'click' into place for the learner - the person feels like they've made a big step forward, which of course they have.

Certain brain (personality) types favour certain skills (see for example the Benziger theory). We each possess natural strengths and preferences. We each therefore find progression to stage 3, and particularly to stage 4, easier in some skills rather than in others. Some people would resist progression even to stage 2, because they refuse to acknowledge or accept the relevance and benefit of a particular skill or ability. In these cases it's obviously not too clever to attempt to progress the person to stage 3. Instead find the person a more suitable role, or allow an adapted approach to the current role if appropriate and viable. People develop competence only after they recognise the relevance of their own incompetence in the skill concerned.

Table 2.2 Conscious Competence Matrix

Competence	Incompetence
3-Conscious competence	**2-Conscious incompetence**
• the person achieves 'conscious competence' in a skill when they could perform it reliably at would • the person would need to concentrate and think in order to perform the skill • the person could perform the skill without assistance • the person would not reliably perform the skill unless thinking about it - the skill is not yet 'second nature' or 'automatic' • the person should be able to demonstrate the skill to another, but is unlikely to be able to teach it well to another person • the person should ideally continue to practice the new skill, and if appropriate commit to becoming 'unconsciously competent' at the new skill • practice is the single most effective way to move from stage 3 to 4.	• the person becomes aware of the existence and relevance of the skill • the person is therefore also aware of their deficiency in this area, ideally by attempting or trying to use the skill • the person realizes that by improving their skill or ability in this area their effectiveness would improve • ideally the person has a measure of the extent of their deficiency in the relevant skill, and a measure of what level of skill is required for their own competence • the person ideally makes a commitment to learn and practice the new skill, and to move to the 'conscious competence' stage
4 - unconscious competence	**1 - unconscious**
• the skill becomes so practiced that it enters the unconscious parts of the brain - it becomes 'second nature' • common examples are driving, sports activities, typing, manual dexterity tasks, listening and communicating • it becomes possible for certain skills to be performed while doing something else, for example, knitting while reading a book • the person might now be able to teach others in the skill concerned, although after some time of being unconsciously competent the person might actually have difficulty in explaining exactly how they do it - the skill has become largely instinctual • this arguably gives rise to the need for long-standing unconscious competence to be checked periodically against new standards	• the person is not aware of the existence or relevance of the skill area • the person is not aware that they have a particular deficiency in the area concerned • the person might deny the relevance or usefulness of the new skill • the person must become conscious of their incompetence before development of the new skill or learning could begin • The aim of the trainee or learner and the trainer or teacher is to move the person into the 'conscious competence' stage, by demonstrating the skill or ability and the benefit that it would bring to the person's effectiveness.

2.2 Competencies of students in the usage of Keyboard

Keyboard skills are essential for children with a visual impairment if they are to use a computer with a 'QWERTY' keyboard. As curriculum demands and the quantity of text produced increases, it is vital for the child to have good keyboard skills. Keyboard skills could be defined as being able accurately and consistently to access the keyboard without visually locating the keys whilst using correct fingering. Accuracy is of far greater importance than speed.

Good keyboard skills enable the child accurately to record their ideas with a word processor, avoiding the frustrations of not being able to find the correct key. If the child has to constantly visually locate the key on the keyboard, the effects of a visual impairment may be exaggerated. When a computer user is able to enter text without visually locating the keys, they demonstrate a much more efficient and effective use of technology. There are many keyboard training applications available. Not all allow you to change and adapt the display on screen.

Teaching keyboarding skills to students who are visually impaired and have additional disabilities could greatly impact their ability to communicate. When students have the skills to exercise control over their environment, it leads to greater independence, increases self-sufficiency and enhances self-esteem.

The whole language approach to literacy in keyboarding is extremely beneficial for students who have difficulty understanding words unless they attach a meaning to the word. According to Goodman (2002), whole language instruction focuses on the experiences of the learner as they build concepts and values. Within this approach, the teacher is the curriculum builder. Meaningful lessons are designed as a result of the

collaborative efforts of the educational team and significant others in the student's home environment. The educational team determines which skills to target for instruction and the parent(s) and/or guardian(s) share their home and community experiences with the educational team. As a result, the student yields the benefits of learning other important skills and concepts, usually taught in isolation, but embedded into this instructional strategy.

This specialized instruction should be provided by a teacher of the visually impaired. Students without vision need help from a specialist to integrate a number of pieces of information in order to develop the concept skills necessary to orient to and understand their environment. The fingers need to be taught to explore and to gather information.

An understanding of the important concepts of spatial awareness, directionality, etc., could be learned while keyboarding. In addition, functional academic skills such as phonics and spelling could be acquired naturally as the student develops a relationship between letter/sound associations to form meaningful words. The student develops a real understanding of a vocabulary that is based on meaningful lessons and experiences while learning to keyboard. The Embedded Skills Chart (Table 1) provides examples of skills that may be taught within this instructional approach while using The Keyboarding Curriculum to Develop Literacy Skills for Students who are blind and have Additional Disabilities, developed by the author (Addendum, 2001).

Teaching the use of the keyboard requires one on one over the shoulder attention using verbal cues and physical prompts. Through the decades, research has demonstrated that the reinforcement cycle of teacher attention and the close proximity of the instructor

affect the student's learning. The reinforcement cycle of teacher attention and approval is usually enough to help the student strive to make correct responses. (Newman & Church, 1990) further contended that the degree of emotional motivation is increased by the close proximity of the instructor. Within this milieu, as the student is typing, provide the student with a phonic hint to help the student spell particular word (Newman & Church).

According to the Goodman, Critts, and Whitmore (1990) study (cited by Mather, l992) most whole language teachers take their cues for instruction from their students. Student preference for a particular verbal prompt should be utilized. Students may indicate a preference for an alternative instructional prompt. For example, when teaching the use of the SHIFT key, a student may indicate a desire to use the prompt let up, rather than release. For students who have additional disabilities this is an effective teaching methodology that complements the whole-language experience approach. The teacher takes advantage of the natural opportunities and teaches to the critical moments of instruction.

In a study conducted in the Western Pennsylvania School for Blind Children, students with visual impairment progressed 50% to 90% accuracy and were able to read and understanding ten, 4-6 letter words each week within four months. An analysis of the typing data revealed that most typing errors occurred with spacing between each word and adapting to the touch sensitivity of the keyboard. The subject's Braille reading errors were due to cell reversals of letters D and Hand cell similarity of letters Q and T. In the following year in that study the decision was made to introduce the subject to the computer keyboard. Instruction progressed to typing compound sentences, paragraphs, and functional stories. The subject had no problem generalizing to the computer

keyboard. Again typing criteria were set at no more than two errors per sentence (including grammar rules, spelling and sentence structure). Data were taken for six successive school months. The results per month were 60%, 60%, 70%, 80%, 80%, and 100% respectively (Stauffer, 2008).

2.3 Students' Competency in Using Job Access With Speech in the Search of Basic Information

Computer assistive technologies are computers with programs that allow students to access the digital environment, promoting individual life and social/education inclusion. Students could benefit from the combined use of these resources with such as screen enlargers (systems that magnify the characters on a computer) and speech synthesizers (specific adaptations with voice output, which convert screen content to speech) (UNESCO, 1994). Any computer when hooked to a voice synthesizer coupled with suitable software transforms itself into a full – fledged talking computer. At this point, all information displayed on the computer screen could be made to speak. One could comfortably navigate the screen and also move to any part of the screen and read the contents there. One could read letter to letter by letter, word by word, sentence by sentence.

The software that works in tandem with the synthesizer to provide these features is generally known as screen reader. There is a wide range of such screen reading software possessing various degrees of capabilities. By far, the commonest screen reader is JAWS. A talking computer opens up a whole world of opportunities waiting to be tapped and exploited. Using a word processor a student with visual impairment could

easily maintain notes, indulge in creative writing and put down ones thoughts in black and white (Kotian & Shamanna, 1999).

Computer assistive technology allows individuals with visual impairment to overcome a major part of the difficulties in daily life and offers them independence and autonomy concerning information management and access to communication, just like their peers with normal vision (Caparos, 1994). Many voice synthesizers and screen readers are available for purchase from companies or nongovernmental organizations or are available for free use on the Internet. These programs allow access to Internet websites.

Various forms of assistive technologies are available to help visually-impaired to live in the electronic environment. Screen reader software speaks aloud what's on a computer screen or mobile phone, including desktop icon labels, document contents, and drop- down and tool bar menu items. An added benefit is that screen readers include shortcut keys that allow visually-impaired to navigate around websites with consistent structures. Visually impaired students could also use mobile phones with screen readers.

JAWS is a computer screen reader program for Microsoft windows that allows blind and visually impaired users to read the screen either with a text – to – speech output or by a refreshable Braille display. A May 2012 screen reader user survey by WebAim, a web accessibility company, found JAWS to be the most popular screen reader worldwide; 49.1% of survey participants used it as a primary screen reader, while 63.7% of participants used it often (WebAim, 2012).

The JAWS enables a visually impaired individual to interact with the computer in the same way a sighted individual would. In an instant, most of the catalogs and databases that constitute the gateway to the various library resources become readily accessible. Mastering the program, though, may not come easily familiarization of facility and its use requires a good deal of practice and training over time. JAWS, when used in conjunction with a browser such as Internet Explorer, would provide the challenged user with a very detailed explanation of the design and structure of the Web page. If the user is new to the page, he or she may have to listen to a reading of the entire page in order to get an adequate sense of its structure; otherwise only relevant parts need be listened to.

Specific navigational key strokes and commands activate the JAWS voice, which announces links, headings, tables, lists, and other features found on the page displayed. In the case of graphics and images, the voice could speak the descriptive alternative text (alt-text) if that text has been properly provided in the design of the page. In addition, quick navigation keys permit the user to enter text such as search terms into the blank field boxes.

While the navigational capabilities of this technology are quite remarkable, its use in practice could present unexpected difficulties. Training over time is obligatory—moreover, each new version of the program issued requires further training. Screen readers read horizontally and move from top to bottom. Frequently the pages being examined are organized in such a complex, counter-intuitive manner that even the experienced user would have difficulty using the tab key in order to find the information sought. Pages with many links and layers, or very long pages, could become extremely

time consuming to navigate. In many instances, insufficient alt-text for graphics, images, and icons could make the information provided meaningless. Although accessibility to PDFs (Portable Document Format pages) has improved over time, some navigation issues remain.

The JAWS is very common software for students with visual impairment students. It is increasingly compatible with more programs and websites, especially as web designers take a more accessible approach to building their web-based contents. Visually-impaired people mainly use screen readers while people with low-vision may access a much wider variety of software applications (Bocconi, Dini, Ferlino, Martinoli & Ott, 2007). Persons with low-vision could use the applications that magnify the screen display in order to facilitate the performance of visual tasks such as reading texts, selecting menus, responding to system prompts and navigating between different parts of websites.

In a study to investigate the use of Information and communication technology (ICT) by the visually impaired students in Calicut University (India), it was observed that Jaws screen reader supported by Windows operating system are the most popular software among the students. It was found that a majority 61 (76.25 %) students uses Jaws.

Screen readers such as jaws provide opportunities to access current information through the Internet (Gerber, 2003), participate in online discussions and develop social networks (Gerber). By using these devices, students with visual impairments could enhance their learning and gain opportunities for equality in education.

2.4 Challenges Associated with the Usagee of Computer Assistive Technology among Students who are blind

A number of barriers exist to the successful and effective use of assistive technology devices among people with various disabilities in school, home, and communities. The barriers to successful and effective use of devices relate to several factors such as limited financial resources (Fifield & Fifield, 1997), high costs of equipment, a lack of knowledge and support from teachers (Alper & Raharinirina, 2006), and eligibility issues for possessing devices.

In the United States, a national survey on abandonment of technology by adults with various disabilities showed that almost one-third of the assistive technology devices were unused due to multiple factors: (a) lack of consideration and willingness to use the devices from the individuals with disability needs;(b) technology tools selected by family members, not the users;(c) complicated design;(d) unreliable equipment; (e) insufficient funding for the assistive technology devices; and (f) lack of technical support .

In another study, Johnson (2011) indicated that a lack of knowledge and awareness among people with disabilities, reluctance to use the devices, poor device performance, changes in needs or priorities, and feelings of stigmatization are major reasons for underused assistive technology devices.

A study by Kapperman et al. (2002), in both elementary schools and high schools in Illinois, showed that between 59 and 71 percent of the students with visual impairments who had potential to use reading devices did not have opportunities to adopt the assistive technology devices. The lack of opportunities were due to insufficient provision of assistive technology devices, insufficient time to provide training for

students, insufficient funds to purchase the assistive technology devices, and lack of appropriate teacher training.

In another study, it was reported that lack of appropriate training among teachers, high cost of the assistive technology devices, insufficient devices produced, and lack of information about the devices were all barriers to effective use of assistive technology in education. These factors also contributed to high rates of abandonment of assistive technology tools among students (Hasselbring & Glaser, 2007).

Copley and Ziviani (2004) identified six barriers to effective use of assistive technology devices among students with multiple disabilities, including: (a) lack of appropriate staff training and support, (b) negative staff attitudes, (c) inadequate assessment and planning processes, (d) insufficient funding, (e) difficulties procuring and managing equipment, and (f) time constraints. In another study by Copley and Ziviani (2004) students with visual impairments faced problems when using assistive technology in seeking information, which included lack of context, that screen readers or magnifiers show small portions of content at any one time; overload of information that slows down content exploration; and excessive sequencing, such as long tables making reading distracting. As a result, these barriers caused abandonment or rejection to the innovation.

Achieving self-esteem becomes difficult for these children since self-awareness in the social context may be affected by such factors as social isolation, low expectations, and over-protection. Such barriers must be carefully examined and skillfully addressed by teachers and special educators in order to provide them genuine and valid access to the general curriculum.

Soderstrom and Ytterhus (2010) investigated the symbolic values and use of assistive technologies from the world of ICT in the daily lives of 11 young Norwegians who were visually impaired. To fit in as ordinary young people the visually-impaired participants rejected ICT assistive technologies whenever possible. The partially sighted participants who were somehow capable of participating in online interactions with their peers without ICT assistive technologies reject them. The blind participants, however, do not have the option of participating online without ICT assistive technologies and, consequently, they accept ICT assistive technologies. This showed that there is a necessity of regulations for visually impaired learners to develop their ICT skills.

Visually impaired students face difficulties in accessing the most basic forms of education. They could use assistive technologies to access traditionally inaccessible educational contents. These technologies are key driving force to equip visually-impaired students to access the digital environment well in the classroom and workplace. However, sufficient training should be provided to visually-impaired students to use different assistive technologies including development of relevant content, provision of software and hardware resources.

Persons with Visual impairment could use screen reading software to access language documents and websites. This software produce audio versions of electronic text and speech recognition programs change what is spoken into an electronic document. However, the most important barrier while using screen reading software is the foreign accent of the software. It is hindering the use of this software.

The students with visual impairment in the calcut study were asked to indicate the difficulties and problems while they use electronic documents and internet with screen readers. Nearly half of the students (47.5 %) face difficulties while using electronic documents and internet with screen reading programs. The foreign accent of screen reading programs is a challenge for the students. It may due to the fact that most of the screen reading software is designed abroad.

Research in the field of visual impairments has, to a large extent, taken for granted that technology has a huge impact on the lives of people who are visually impaired. Many professionals in the field understand, at least anecdotally, that computer use, AT, and access to the Internet could make a tremendous difference in the lives of individuals with visual impairments--improving educational and employment opportunities, enhancing social networks (by e-mail and online groups), and facilitating independence (with personal access to information). Yet little research, particularly qualitative research, has been conducted to document the importance of computers and computer related AT, in the lives of individuals who are visually impaired. A few relevant studies have attempted to document the impact of technology, particularly computer-related AT, on classroom performance, general literacy, job placement and maintenance, and overall quality of life (Craver & Burton – Radzely, 1998).

In many studies, it has been demonstrated that ICT, is not only reducing barriers of access, but at the same time creating barriers. People with visual disabilities face special barriers in using the Internet, aside from those related to material access and computer related trainings. Bayer and Pappas (2006) mentioned technical accessibility problems are one of the extra barriers that people with a visual impairment need to tackle.

They found out that especially navigation and screen reading posed problems for blind internet users.

Consumers who are visually impaired and professionals in the field of visual impairments have long been aware of the lack of adequate computer training. (Bayer and Pappas) documented that the shortage is at a "crisis level." The participants' concern about the lack of training, the cost of available trainers, and the lack of ongoing information that would allow people to "train themselves" was great.

2.5 Assistive Technology

According to Govinder (2009), the term ‘‘assistive technology’’ encompasses a broad range of assistive devices from ‘‘low tech’’ to ‘‘high tech’’ learning tools. To him, low-tech examples include pencil grips, highlighters, paper stabilizers and high-tech examples include computers, voice synthesizers and braille readers. Furthermore, (Govinder, 2009) points out that assistive technology device are any item, piece of equipment, or product system (software) used to increase, maintain or improve the functional capabilities of a student with disabilities. In a more recent definition, indicates that assistive technology can be defined as any piece of equipment, or product, whether it is acquired commercially, modified, or customized, that is used to increase, maintain or improve the functional capabilities of a student with disabilities. Assistive technology is important because, for some students, without assistive technology they would not have access to or be able to benefit from their educational programme. According to Weiter and Hastein (2003), teaching materials based on ICT, mechanical devices or printed paper all aim to fulfil a double purpose. Firstly, there is a target to fulfil the function for

which they are designed for; secondly, they serve as a means for inclusive education. We think it is important to think through and draw practical consequences deriving the close functions between these two. The types of assistive technology in the classroom may be in place to aid in the following area: Computer Access, Compositing Writing Material, Communication, Mobility and Vision (Weiter & Hastein).

2.6 Understanding the Role of Computer Assistive Technology

The United Nations defines assistive technology as technology adapted or specially designed to improve the functioning of people with disabilities (Borg, J., Lindstrom, A., and Larsson, S. (2009). In the United States, assistive technology refers to "any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities". Hardware such as screen magnifiers and alternative keyboards, and software such as optical character recognition, onscreen keyboards, and voice recognitions are all types of assistive technology.

Based on general definitions of assistive technology, Blackhurst and Lahm (2000) elaborated that assistive technology devices include the following: mechanical, electronic and microprocessor-based equipment; non-mechanical and non-electronic aids; and specialized instructional materials, services, and strategies that people with disabilities use to: (a) assist learning, (b) make the environment more accessible, (c) compete in the workplace, (d) enhance independence, or (e) improve quality of life. Blackhurst and Lahm (2000) grouped assistive technologies into seven categories, which include positioning and seating, mobility, augmentative and alternative communication, computer

access, adaptive toys and games, adaptive environments, and instructional aids. In contrast, Blackhurst and Lahm classified assistive technologies into thirteen categories based on the task for which each is useful: (a) computer access, (b) motor aspects of writing, (c) composing written material, (d) communication, (e) reading, (f) learning/studying, (g) math, (h) recreation and leisure, (i) electric aids for daily living, (j) mobility, (k) vision, (l) hearing, and (m) vocational. (Wong & Cohen, 2011) considered services for assessment, training, adaptation, and technical assistance as assistive technology.

The other general classification of assistive technology devices includes a spectrum of equipment, from high to low tech that could be applied in writing, reading, access to computers, communication, mobility, and leisure. The low-tech devices do not require onerous training and are inexpensive. Examples of low-tech devices are handheld magnifiers, large print texts, and canes. In contrast, high-tech devices refer to more sophisticated tools requiring special training to use the devices effectively. The devices are considered more expensive such as voice recognition, electronic organizers, digital hearing aids, and communication devices with voices.

In educational settings, assistive technology refers to any technological tools or devices that help students with disabilities to access learning materials and perform learning tasks easily. The types of assistive technology for students who are blind or low vision are classified into four main categories. This is shown in Table 2.1 (Presley & D' Andrea, 2008).

Table 2.1 Types of assistive technology for students with visual impairment

Types of technology	**Devices**
Technology for accessing print material	large print, reading stand, acetate overlays, lighting, handheld and stand magnifiers, telescopes, video magnification systems, scanning and optical character recognition(OCR) systems, electronic whiteboards, Braille reading, tactile graphics, digital talking books-book readers, talking calculators, talking dictionaries.
Technology for accessing electronic information	large monitor, adjustable monitor arms, cursor enlarging software, screen magnification software, accessible Personal Digital Assistant (PDA), large print, online dictionaries, refreshable Braille displays, touch tablet, text reader, self-voicing applications, e-book reader, digital voice recorder.
Technology for producing written Communications	felt-tip pen and bold marker, dedicated word processor, imaging software, drawing software, Math software and spreadsheets, slate and stylus Braillewriter, electronic Braillewriter, Braille translation software, Braille embosser, Accessible PDA.
Technology for producing materials in alternate formats	Scanning and optical character recognition (OCR) system, laser print, Braille translation software, Braille embosser, graphics software, fusers and capsule paper, digital and analog audio recording device.

Source: Presley & D' Andrea, 2008

2.7 Assistive Technology for pupils with Low Vision

Kapperman and Stiken (2000) observed, the ability to access information is essential for success in education, employment and life. Therefore, much of the development of assistive technology has focused on providing access to information. In particular, devices to read and write Braille and print have significantly improved with the application of new technology. Such devices include audio technology (tapes and tape recorders, auditory text, recorded texts and synthetic speech) as well computer based technology such as Braille embossers (specialized tactile printer) advanced CCTV, scanners and optical character recognition software (technology that scans printed text and provide the user with speech output), computer screen readers, Compact Disc (CDs) and multiple hardware and software innovations. Computer assistive and technology are often cited as the means to overcome limited access to print and other environmental barriers for non-print readers (Gerber, 2003). Gerber notes that plethora of researchers and practitioners in the field of visual impairment have acknowledged that the use of computers and assistive technology can change the lives of pupils with visual impairments to a great extent by improving education and employment opportunities, enhancing social network and facilitating independence. In essence, assistive technology has the potential to be the ‘‘great equalizer’’ for persons with visual impairments Kapperman & Sticken, 2000). For instance many careers opportunities requiring access to visual information are now accessible to those who have visual impairments through the application of appropriate technology. It is generally accepted that assistive technology has positive impact on the lives of the persons with visual impairments (Kapperman, & Sticken). However, the advance in technology on the other hand has been

cited as a factor for declining Braille use and Braille literacy. In addition, assistive technology omits grammatical structure, spelling and traditional text formats. Therefore, as assistive technology market continues flourishing with devices and software that make the visual world significant more accessible to person with impairment, educators need to evaluate their applicability and effectiveness to literacy related needs.

(Kapperman & Sticken) opined that, most students with visual impairments find that they need some type of device to help them to be effective learners in school settings. Students who are visually impaired but have at least some useful vision are often able to rely on large print materials, specialized magnification lenses, or electronic enlargement for the assistance they need. Even those with no useful vision, who traditionally have had to rely on tape recordings or translations into Braille, now, have access to many other devices that can help them become independent learners. For example, descriptive video services (DVS), which provide narrative verbal descriptions of visual elements, have proven useful in helping students who are blind or have low vision to use educational programs in regular classrooms. Synthetic and digital speech synthesizers, mentioned earlier as output devices to assist students with communication disorders, are also helpful to those with visual impairments. With these text-to-speech applications, sometimes referred to as "screen readers," students who are visually impaired can have any text found on the computer screen read aloud. Text-to-speech technologies also facilitate the rereading and editing of previously written text, thus providing opportunities for students with visual impairments to participate in such tasks alongside their nondisabled peers (Goodman, 2002).

Another computer-based application, Optical Character Recognition software can scan and read text aloud, allowing individuals with visual impairments greater access to all types of print materials and enabling them to "read" the materials independently. Optical Character Recognition software is now available for most computers and scanners, and several dedicated portable devices have also been developed, making them more users friendly. Although current technology cannot read handwritten materials accurately, this barrier will likely fall by the wayside in the very near future. Finally, advances in computer technology have made even the use of Braille more useful. A number of software applications have been developed that combine Braille with computer technology, such as Braille note takers-small, portable devices that can store Braille characters and read text aloud-to assist students with visual impairments in the classroom (Kurzweil, 2002).

According to Kurzweil (2002), the following devices are helpful to students with visual impairments. Firstly, Closed-Circuit Television Magnification (CCTV) is designed to enlarge any type of text or graphic material by using a small vertically mounted video camera with a zoom lens directly connected to a monitor for displaying the image. The text or graphic material is placed under the camera lens on a sliding reading stand and the image is projected on the attached video monitor. Closed-Circuit Televisions allow the user to adjust the magnification, contrast, brightness, and focus, and to change the background display to either black or white, or in some cases, colour. Older CCTVs, while still useful for many classroom applications, are expensive and cumbersome to move. But the newer, smaller versions of this technology are portable, and thus much easier for students to use (Kurzweil, 2002).

Secondly, Computer Screen Magnification: Most computers sold today allow for the magnification of the screen through the use of special software. Typically, the user can select a portion of the screen and then enlarge that section up to 16 times the original size. Although the user is somewhat inconvenienced by having to view a smaller portion of the original screen as the magnification increases, this technology makes it possible for students with visual impairments to use computers in ways similar to their nondisabled peers (Kurzweil, 2002).

The third device, according to Kurzweil (2002), is Descriptive Video Services (DVS): DVS technology inserts a narrative verbal description of visual elements—such as sets and costumes, characters' physical descriptions, and facial expressions—into pauses in a program's dialogue. The majority of television sets and VCRs manufactured in the past six years have been designed with a "second audio program" (or SAP) switch that can be turned on so that the user can automatically hear descriptive video. DVS is available for both standard VHS and DVS formatted videotapes. DVS technologies help students by providing them with access to information, and through the increased opportunities to discuss programs and movies that are part of the popular culture, by providing them with opportunities for increased socialization and knowledge building.

Kurzweil (2002) again stated that, screen reader software represents what is known as a text-to-speech application, which analyzes letters, words, and sentences and converts them into synthetic or digital speech. Today, text-to-speech software is common in many software packages, including many word processing and educational software programs in math, reading, and spelling. In some instances, the student can adjust the volume, pitch, and speed of reading, and even choose between a male or a female voice.

With synthetic speech, the computer reads text passages, analyzes the phonetic structure of words, and attempts to reconstruct the words by putting together a string of synthetic phonemes that are then "spoken" by the computer. However, when the words are not phonetically predictable, the results can be difficult to understand. In contrast, digital speech is composed of actual recordings of human speech. While digital speech is much easier to understand, it requires a large amount of storage because each word that the computer may encounter must be pre-recorded. Consequently, its use is often not feasible for classroom instruction. As more low-cost options for storing electronic information become available, however, this technology will likely be used more extensively to assist students who have communication disorders or visual impairments (Kurzweil, 2002).

Also, Optical Character Recognition (OCR): OCR technology enables individuals with visual impairment to place books or other print materials on a scanner and have the text interpreted and read using synthetic or digital speech. The first OCR system for individuals with visual impairments was introduced in 1976, when Ray Kurzweil invented the Kurzweil Reader. The early Kurzweil Reader was about the size of a small photocopy machine and was considered to be a truly remarkable advance for students with visual disabilities. While the device was often found in libraries, it was too bulky and expensive to be available to students in the classroom. Today, there are portable stand-alone OCR devices and devices that can attach to other computers and scanners (Kurzweil, 2002).

Finally, Kurzweil, (2002) opines that, Braille note-taker play essential role in the learning needs of individual with visual impairments. Braille note-takers are small, portable devices that enable students to enter and store Braille characters in the form of

words and sentences. The note takers use the same six keys found on a traditional Braillewriter used for making a paper copy of Braille. However, most note takers allow users to review what they have written by listening to the text-to-speech function of the device. In addition, software translators allow the Braille to be converted into text. The stored files can then be used with a standard word processor or a screen reader. To get a hard copy of the information that was entered, the user can connect the note taker directly to a standard printer for text output or a Braille printer for Braille output. Similarly, a paperless Braille display can be attached to a computer or a personal note taker that can display up to 80 characters simultaneously. Devices such as the Braille note taker that combine Braille with computer technology have made Braille much more useful than it was in the past (Kurzweil, 2002).

Computer technology and internet have increased the independence of students with special needs (Smith, 2008). Those who have difficulty leaving their homes for the classroom can now log in and attend lectures online, research health questions, participate in online discussions, catch up with friends, or make new friends. Persons with Visual impairment students, who used to wait months or years for the information they needed to be available in Braille or on audiotape, can now access the very same news stories, magazine articles, government reports, and information on their education at very same time it become available to the sighted population. People who have difficulty holding a pen or using a keyboard can use the latest speech recognition software to write letters, pay their bills, or perform work-related tasks. If a student cannot access the computer in its standard form and they need it to perform academic tasks, this technology helps come

along with word prediction, switches, voice recognition software, alternate keyboards and pointing options.

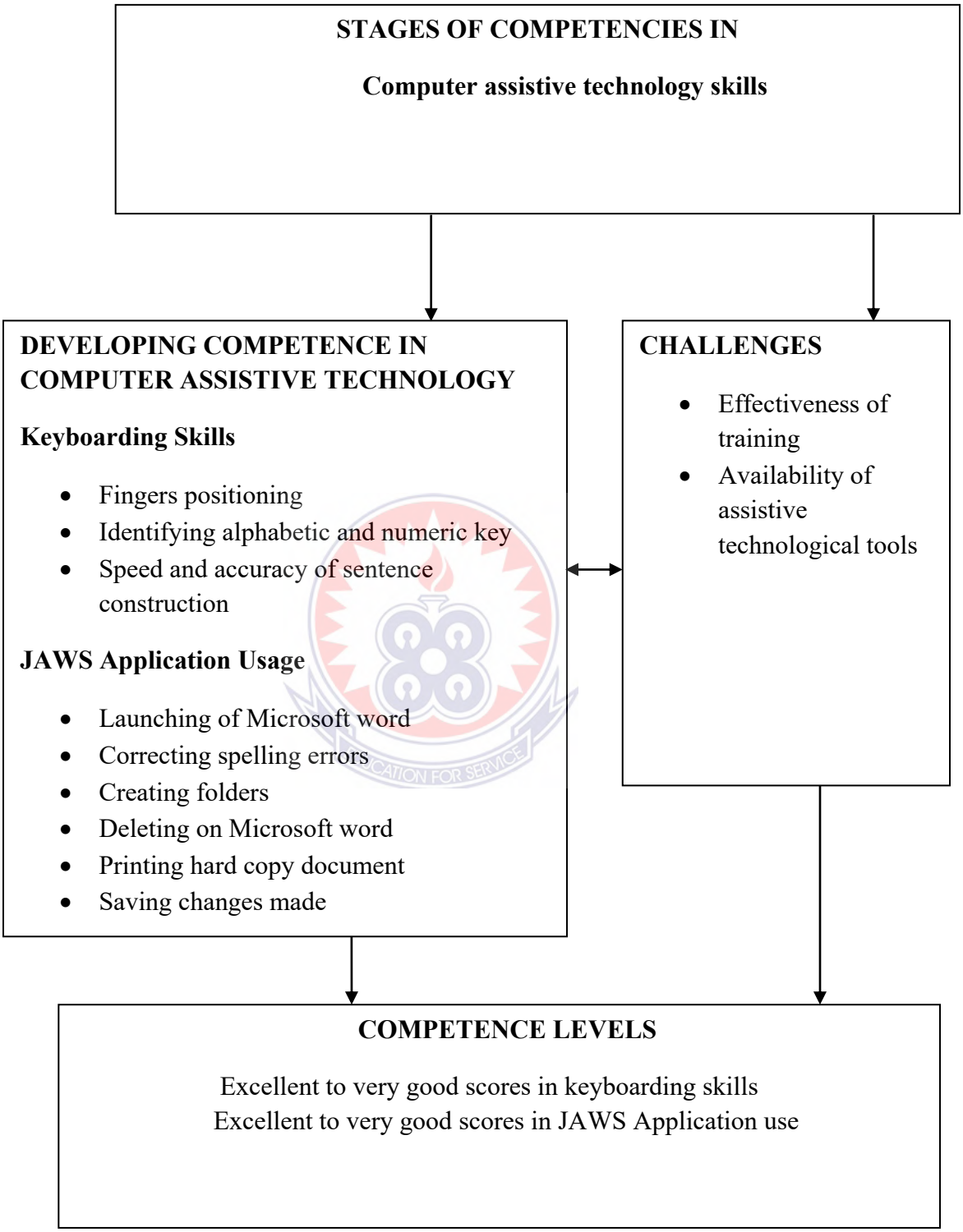
Assistive technology devices have become an essential tool for students with visual impairment. In an educational setting, the benefit of using assistive technology devices in teaching and learning has been widely studied in recent years (Hussin, H., Mohd, NR. and Suhaimi, MA. (2008). Studies showed that assistive technology devices have a positive impact on students with visual impairments' lives, such as motivating students Cooper and Nichols (2007) and developing positive relationships in their academic achievement (Trucano, 2005).Studies have been conducted on the effect and usefulness of assistive technology in students with learning disabilities. Scholars found that assistive technology devices have positive impact on students' learning, specifically, increasing reading speeds and comprehension rates (Corn, & Bell, 2002).

Assistive technology devices are essential for students with visual impairments to enhance learning, cognition, and social development. Researchers and practitioners acknowledge the use of assistive technology devices could change the lives of students with visual impairments. These devices have a positive impact on educational performance, including helping students access and understand three dimensional and non-linear illustrations in math.

Estimates predict that individuals with visual impairments (that is, those who are blind or have low vision) are much less likely to use computers than are sighted individuals. The U.S. Bureau of the Census's Survey of Income and Program Participation(Gerber & Kirchner, 2001), indicated that 21% of all non institutionalized individuals aged 15 and older with "functional limitations in seeing" have access to the

Internet; only 13% of the same population reported using a computer on a regular basis (Gerber & Kirchner). The rates among the nondisabled population are 57% and 51%, respectively. Although this discrepancy in the use of computers is staggering, these data are insufficient to explain how and when these technologies are used and in what ways they make a difference in people's lives.

Conceptual framework of the study



2.8 Summary of Literature Review

The scientific literature that has been reviewed pointed out that assistive technology defies a single definition. The lack of a single definition accounts for varied classifications of what constitute assistive technology. That notwithstanding, the other general classification of assistive technology devices includes a spectrum of equipment, from high to low tech that could be applied in writing, reading, access to computers, communication, mobility, and leisure. In the context of research focus, the discussions have indicated that assistive technology refers to any technological tools or devices that help students with disabilities to access learning materials and perform learning tasks easily. However, the discussion also pointed out that, students' competence at using the various components of these devices is necessary to guarantee effective teaching and learning within the educational setting for the visually impaired. Two dimensions of these devices have been considered in line with the objectives of this study. These include keyboard use and JAWS. It was also clear that developing students' competencies in these two dimensions have not come without challenges.

CHAPTER THREE

METHODOLOGY

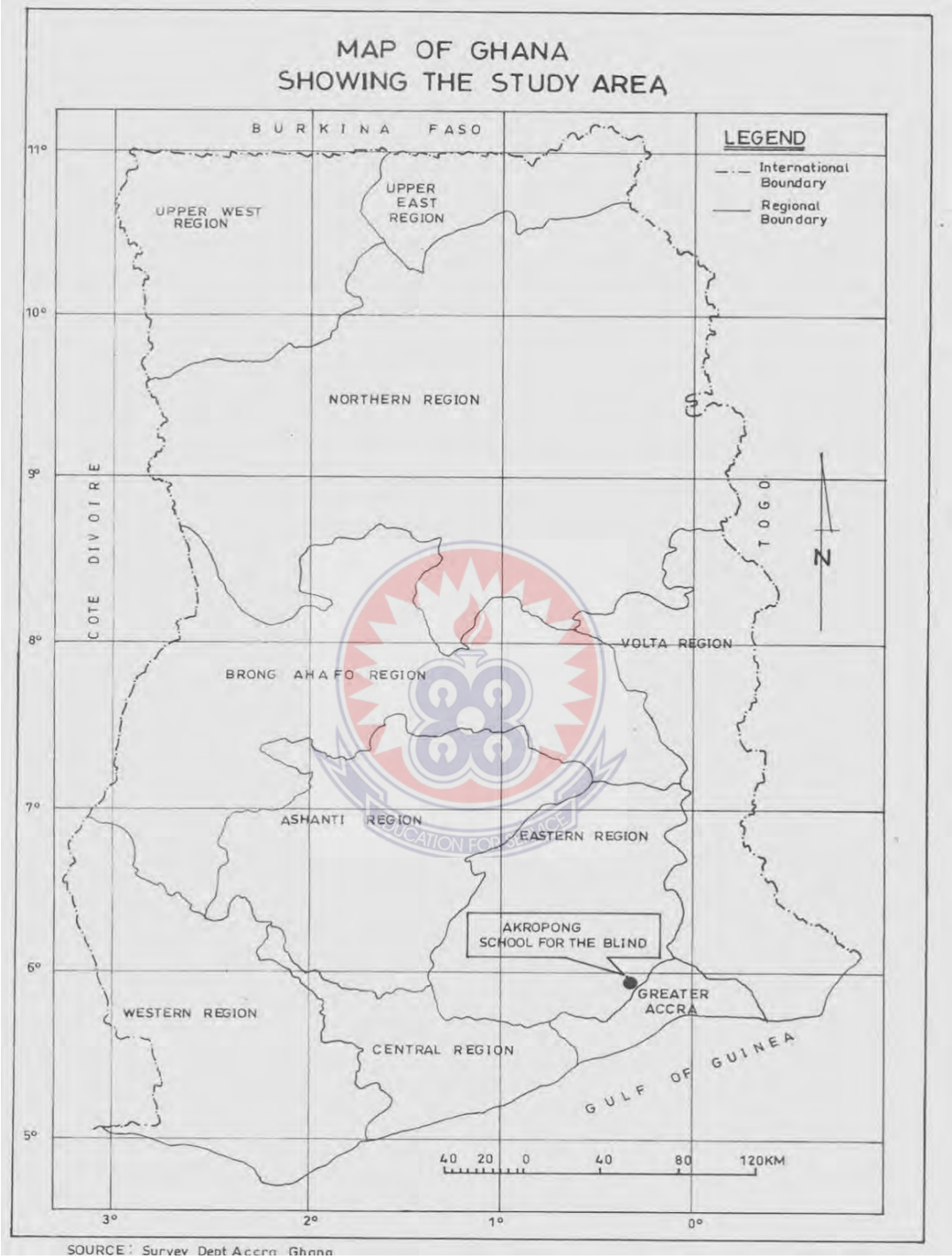
3. 0 Introduction

This chapter presents the methodology for the study. The areas covered study Area, research design, population, and sample size, sampling Technique, instrumentation, reliability, validity, procedure for data Collection and data analysis and Ethical Considerations.

3.1 Study Area

Ghana has two schools for the Blind; WA and Akropong Schools for the Blind. Akropong is the capital of the Akwapem Traditional Area. It is located in the Eastern Region of Ghana and in the Akwapem mountainous terrain, about 30 miles from Accra, the capital city of Ghana. The purpose for which it was established was to train children with blindness and integrate them into mainstream society. It was a significant day chosen to illuminate and alter the outlook and the social image of the blind in the country. According to records available at the school, it was first started on the premises of the Presbyterian College of Education (PCE), formerly Presbyterian Training College (PTC) at Akropong Akwapem. It is the first special education facility for the persons with visual impairment in West Africa to be initiated by the Presbyterian missionaries.

3.2 Map of Ghana showing Akropong School for the Blind



3.3 Research Design

A mixed research strategy was adopted to guide the study of data collection. According to Yeasmin and Rahman (2012), the choice of a researcher to adopt a mixed methods strategy is largely motivated or influenced by the research questions posed which are directed at describing, explaining, observing, verifying and drawing a conclusion which are the basic underpinnings (tenets) of both quantitative and qualitative strategies. Thus, my choice of mixed research methods was motivated by the research questions I raised, which were aimed at describing, explaining, observing and verifying, as well as, drawing a conclusion.

Subsequently, the case study research design was adopted because of its appropriateness to achieve the study objectives. This is because; according to Cohen and Manion (2000) the case study focuses on describing, examining and explaining a phenomenon. This design was also selected because Bryman (2008) suggests that, it supports the mixed method research approach which was used in the data collection, analysis and presentation of field findings. Akropong School for the Blind was therefore considered as a single case to investigate students' competence in the use of computer assistive technology.

To achieve this, the researcher spent time interacting with the students and collected extensive data using a structured self design computer competency test and in-depth interview guide. The computer competency test was design with two major components which focused on the first two objectives measuring the students' competence on keyboarding skills and JAWS.

3.4 Population

The population for the study constituted all 105 students at the Akropong School for the Blind. Population of a study is the sum total of the phenomena which are of interest to a researcher. Population of a study may include people, objects, and institutions which are the objects of the study. Creswell (2005) states that a population refers to group of humans selected for a study.

3.5 Sample size

The sample size for the study was 35 students in the second year Junior High School; this was made up of 23 males and 12 females.

3.6 Sampling Technique

A purposive sampling technique was used. With this technique, the researcher chose the sample based on who is appropriate to provide the relevant information to achieve the research objectives. The 2nd year students were chosen because the researcher perceived that they might have attained some degree of mastery in computer use. Even though the final year students would have been appropriate they were left out because they needed more time to prepare for their examination and therefore were not involved.

3.7 Research instrument

Research instrument use to gather data for this study were self design computer competency test. This was made up of (9) items which the first three questions measures students competency in the usage of keyboard and the second part measures students

competency in the usage of JAWS. Students were scored according to the BECE system of grading information technology in line with the model adopted for this study. This helps the researcher to determine their stages of unconscious incompetent to unconscious competent. See table 3.1 below

Table 3.1: Adopted GES Grading System in ICT and its interpretation to the conscious competent learning model adopted

Qualification	Marks obtained	Interpretation
Excellent	80 % and above	Unconscious-competent
Very good	70% - 79%	
Good	60% - 69%	Conscious-competent
Credit or Average	50% - 59%	Conscious-incompetent
Weak or Poor	45% - 49%	
Fail or Very poor	39% and below	Unconscious-incompetent

Also an in-depth interview guide was used to solicit student's ideas on challenges to computer assistive technology use. It was made up of (9) items. This help to generate qualitative data for the study.

3.8 Validity

The study adopted the BECE system of grading student which has been used throughout the country in Ghana and it has been certified valid by professionals (report from WAEC office 2014).

3.9 Reliability of the Study

A pilot study was conducted for 12 students from Wa School for the Blind. The 12 students comprised 8 Males and 4 Females the test was conducted for thirty minute on 6th December, 2014 in the morning starting from 9:00am to 9:30am. The self designed computer competency test was conducted by the ICT master and the researcher and one research assistant playing a supervisory role. This is because the teacher's voice was very familiar and clear to the students. Cronbach's Alpha value for the factors identified from the test was .934, which is higher than the 0.70 that is generally accepted in social science research. The internal consistency of items in the test instrument was thus highly reliable meaning that the coefficient level was high for the instrument to be used.

Table 3.1 Cronbach's Alpha for Validity and Reliability

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.934	.943	9

The reliability scales (Cronbach's Alpha values) for the factors identified was .934 (see table above) which are higher than the 0.70 which is generally accepted in social science research. Therefore the instruments can be said to be relevant and reliable in measuring what they are supposed to measure.

3.9.1 Procedure for Data Collection

The researcher obtained a letter of introduction explaining the research focus to the authorities at Akropong School for the Blind see UEW (Appendix III). Upon receiving the permission the researcher visited the School to collect data from the students. The self design computer competency test and interview guide were administered to each student independently by the ICT teacher with the researcher and the research assistant playing the assisting role of recording and transcribing the views expressed by the students. This was deemed necessary because the researcher believed that, the students are very familiar with the voice of the teacher and would be more

obliged to follow the guidelines and rules issued as he took them through the test. However, the researcher qualified issues where necessary in explaining questions to students.

The data collection process was conducted in the (ICT) lab at Akropong School for the Blind because it had a very congenial atmosphere. Each session lasted for thirty five minutes from 9:00 am to 9:35 am following the time allocation for computer lesson on the school's time table for a period of 10 days.

3.9.2 Data Analysis

The data generated from the practical computer competency test was entered into the Statistical Package for Social Sciences (SPSS, version 16) for analysis and these findings were presented using the descriptive statistical tools of frequency tables and charts. The transcribed data from interviews were analyzed thematically. That is the key themes were identified in the conversations and these were drawn and discussed. This was done using both the narrative methods and opened quotes from interviews.

3.9.3 Ethical Consideration

For ethical clearance, the researcher ensured that the students who participated in the study did so voluntarily without any form of coercion. To guarantee their confidentiality, the researcher did not ask students to provide data that reveals personal identification. The rights of respondents and other parties involved at every stage of this study were particular treated with utmost care. The following considerations were made

to promote and protect the rights and interests of participants at the difference stage of the study.

As a procedure to gain access to the school, an introductory letter from the Department of Special Education, UEW was presented to the authorities of the schools. Parents of the students were informed through (P.T.A) meeting. The researcher told the participants of their right to participate voluntarily or withdraw from the study at any stage if they deemed it appropriate to do so. Anonymity and privacy of participants were guaranteed by asking them not to write their names on the self design computer competency test and the interview guide. To try to make participants informed before signing the letters of informed consent, the purpose of the study, the risk and benefit of the study were explain to participant. Participants were also verbally assured that there would be confidentiality in the handling of any data or information obtained from them.

3.10 Chapter Summary

The chapter has provided the roadmap for the data collection. In the first place, it has revealed that, the study was conducted at Akropong School for the Blind, which is one of two schools for persons with visual impairment in Ghana. The other, Wa School for the Blind was used as the place for piloting the field data collection instruments to test the validity and reliability dimensions of social research. The mixed research strategy following a case study design was adopted to guide the data collection, analysis and presentation of both the quantifiable information from questionnaires and the qualitative interpretation of interview reports in line with research objectives.

CHAPTER FOUR

DATA ANALYSIS

4.0 Introduction

This chapter presents the data analysis and discussion of findings. The findings are presented under sub-themes in line with the research questions raised. The chapter is divided into five parts. These include the demographic characteristics of respondents, overview of the computer assistive technology at Akropong School for the Blind, students' competency in the use of keyboard at Akropong School for the Blind, students 'competence in the use of Job Access with Speech (JAWS) at Akropong School for the Blind and challenges associated with computer assistive technology use among students at Akropong School for the Blind.

The study used the grading system used by the Ghana Education Service for the Basic Education Certificate Examination to ensure that the research findings are reliable and that the conclusions drawn are valid. This would provide the basis to determine the competence of the students in relation to keyboarding skills and JAWS. The grading system is illustrated in table 4.1.

Table 4.1: Adopted GES Grading System for BECE

Qualification	Marks obtained
Excellent	80 % and above
Very good	70% - 79%
Good	60% - 69%
Credit or Average	50% - 59%
Weak or Poor	45% - 49%
Fail or Very poor	39% and below

4.1 Demographic Characteristics of Students

This section discusses the demographic characteristics of the students in JHS two at Akropong School for the Blind to give an overview of the characteristics of respondents in the study. The parameters discussed include age and gender of students.

4.1.1 Age of Students

Table 4.2 shows that in a class of 35 students in JHS 2, 16 respondents (45.7%) were within the age range of 12-16years. Ten (10) respondents (28.6%) were below 12years while the remaining 9 respondents (25.7%) were aged above16 years.

Table 4.2: Age of JHS Students Akropong School for the Blind

Age (Years)	Frequency	Percent (%)
Below 12	10	28.6
12-16	16	45.7
Above 16	9	25.7
Total	**35**	**100.0**

Source: Field survey, 2014

4.1.2 Gender of Students

It is observed from table 4.3 below that the class has a higher male population than female. Out of a total number of 35 respondents, 23 (65.7%) were males while their female counterparts were 12 (34.3%).

Table 4.3: Gender of JHS Students Akropong School for the Blind

Gender	Frequency	Percent
Male	23	65.7
Female	12	34.3
Total	**35**	**100**

Source: Field survey, 2014

4.2 Overview of the Computer Assistive Technology usage at Akropong School for the Blind

It was found out that Akropong School for the Blind has a computer laboratory centre with 31 installed desktop computers. The ICT teacher reported that the computers were provided by MTN-Ghana, a mobile telecommunication network. The findings showed that all the students who were currently in JHS Two were introduced to ICT in Class One. Currently, they have two lessons every week and the duration for each lesson was 35 minutes. These lessons are taught on Tuesdays and Thursdays.

It has been noted that keyboarding skills are essential for children with visual impairment if they are to use a computer. Observations from the laboratory confirmed that all the keyboards of the computers are of the "QWERTY" standard. Most of the

students had challenges with the keyboards and this would be discussed later in this discourse.

The JAWS enables a visually impaired individual to interact with the computer in the same way a sighted individual would. It is a software computer screen reader program for Microsoft windows that allows visually impaired users to read the screen either with a text – to – speech output or by a refreshable Braille display. Even though there are various software programs in this regard, the researcher focused on JAWS because is the most popular screen reader worldwide (WebAim, 2012). The findings from the study revealed that the role of JAWS software as an assistive technology is mainly to magnify computer tasks through voicing. This has been mounted on the computers and is supported by Window Operating System (windows 7).

4.3 Objective One (1): Students' Competence in Keyboarding Skills at Akropong School for the Blind

Keyboarding skills per this study was understood as the ability to accurately and consistently access the keyboard without visually locating the keys whilst using correct fingering. To achieve this, the researcher tested the students on three dimensions of keyboard use and these include; fingers positioning; ability to identify alphabetic and numeric keys and the speed and accuracy of typing. A practical test of using the keyboard to type a typical question was applied to all students and scored according to the BECE grading system in Ghana.

4.4 Positioning of Fingers on Key

From table 4.4, it could be seen that 21 (60%) of the students were able to position their fingers excellently on the keyboard. Based on their performance in line with the conscious competence matrix, these students were judged as having attained unconscious competence, and are thus in stage four within the conscious competence matrix. Those who scored very good were 7 (20%) and because their performance was also remarkably high, they have attained conscious competence with finger positioning on the keyboard. In addition, 5 (14.3%) were good and were judged to be within the conscious incompetence stage while the remaining 2 (5.7%) performed averagely in positioning their fingers on the keyboard and were perceived to be within the unconscious incompetence stage.

Table 4.4: Ranking of Students on Finger Positioning on Keyboard

Ranking	Frequency	Percent (%)
Excellent	21	60.0
Very good	7	20.0
Good	5	14.3
Average	2	5.7
Total	**35**	**100.0**

Source: Field survey, 2014

4.4.1 Ability to identify difference between alphabetic and numeric keys

The ranking of the students who were able to identify the alphabetic and numeric keys in keyboard usage is shown in figure 4.1 below. The scores indicate that 16 (45.7%) of the students could excellently identify the difference between the keys and were

therefore perceived to have reached the unconscious competence stage. This was followed by 13 (37.1%) of them who had very good and were considered to be consciously competent. Four students (11.4%) scored good and were judged to be consciously incompetent while 2 students (5.7%) scored average and were considered to be unconsciously incompetent. The results show that these students had not met the standards as demanded by the curriculum since they still operate only at a lower grade.

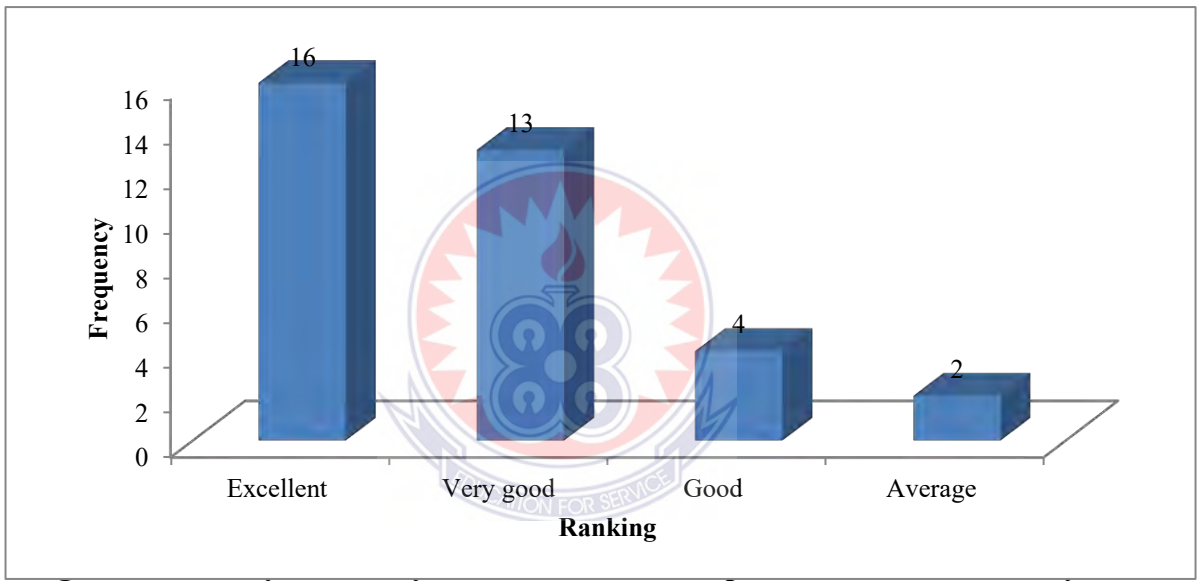


Figure 4.1: Ability to identify difference between alphabetic and numeric keys

Source: Field survey, 2014

4.4.2 Speed and Accuracy in Typing

The relevance of one's keyboarding skills is epitomized in his or her ability to type or input data into the computer. The students were asked to type the following sentence ***"The quick brown fox jumps over the lazy dog***". Emphasis was placed on

measuring accuracy than speed. Table 4.5 below, illustrates the performance of students on speed and accuracy in typing.

Table 4.5: The Speed and Accuracy of Sentence Construction

Ranking Grading for Test Score	Frequency	Percent (%)
Excellent	4	11.4
Very good	6	17.1
Good	8	22.9
Average	5	14.3
Poor	3	8.6
Very poor	9	25.7
Total	**35**	**100.0**

Source: Field survey, 2014

From table 4.5, only 4 students (11.4%) scored excellent in relation to speed and accuracy. This category of students accurately typed the sentence without errors and as a result, they were perceived to have attained unconscious competence. Six students (17.1%) also scored very good; this category made some minor errors hence were considered as being consciously competent. Eight students (22.9%) scored good and were deemed to have reached the conscious incompetence stage while all those who scored average, poor and very poor made numerous errors. As a result, they were perceived to be unconsciously incompetent because despite their numerous computer lessons since class one to JHS Two, they were yet to acquire basic understanding of constructing a short sentence.

4.5 Objective Two (2): Students' Competence in Using Job Access with Speech (JAWS) at Akropong School for the Blind

To measure their competence in relation to JAWS, the students were tested on the following dimensions: launching Microsoft Word, correcting an error in spelling; creating folder; deleting characters/words/sentence, printing hard copy and saving changes made to a document using the JAWS application.

4.5.1: Students competencies in launch Microsoft Word using JAWS

According to Kotian and Shamanna (1999), using a word processor by a student with visual impairment could easily maintain notes, indulge in creative writing and put down one's thoughts in black and white. Figure 4.2 below, indicates the performance of the students at Akropong School for the Blind in using JAWS to launch Microsoft word. Eleven students (31.4%) were excellent at launching Microsoft Word using JAWS hence are in the unconscious competence stage, while the highest response of 18 (51.4%) students were very good and were considered as being consciously competent.

The results show that additional lessons and practice times was required for this category of students could easily migrate to the fourth stage of the conscious competence matrix. 5 (14.3%) students were good and considered as being consciously incompetent while only 1 student (2.9%) scored very poor. This student completely failed to launch Microsoft Word using the Job Access with Speech and therefore, was judged as being unconsciously incompetent.

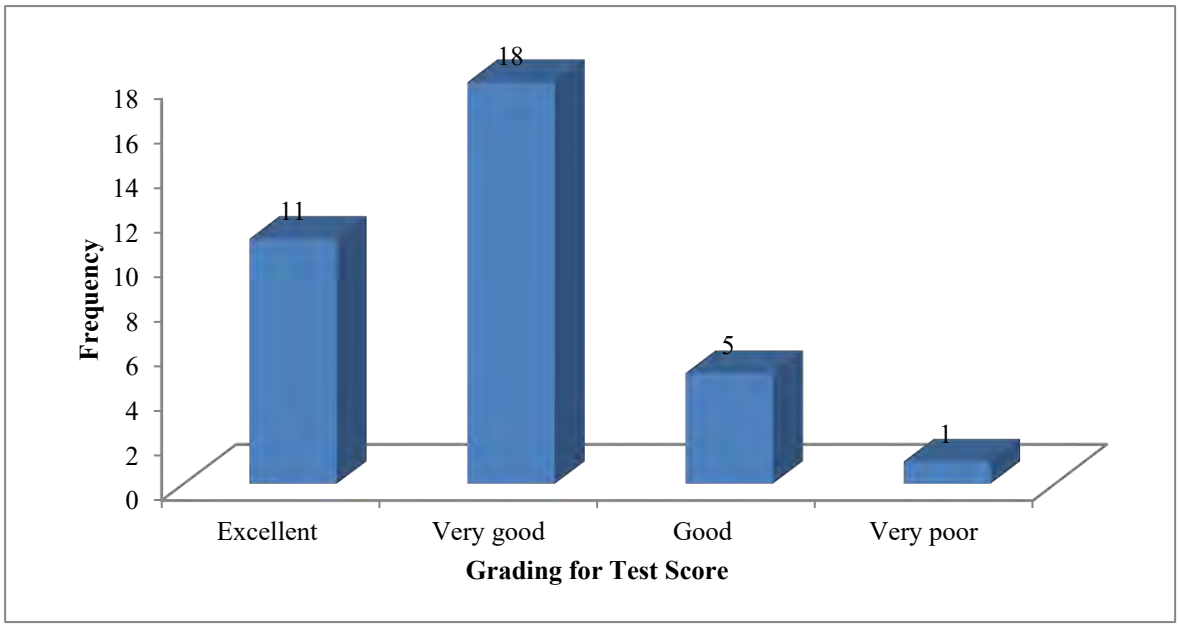


Figure 4.2: Launching Microsoft Word using JAWS

Source: Field survey, 2014

4.5.2: Students competency in correcting a Spelling Error using JAWS

The focus was sought how the students correct the mistakes in typing the sentence "***The quick brown fox jumps over the lazy dog***" which was illustrated in table 4.5. From table 4.6, a total of 4 students (11.4%) scored excellent and because they personally effected these corrections without any assistance from the tutor, they were judged as being unconsciously competent. Twenty three (65.7%) students were very good in correcting their errors. This category though received some assistance to effect their changes, it was very minimal and as a result, they were judged as being consciously competent in this regard.

In addition, a total of 6 (17.1%) students were good in making these corrections, but they received greater assistance as compared with those who scored very good. As a result, they were judged as being consciously incompetent. A cumulative total of 5.8%

students failed to accurately correct their errors personally and therefore required maximum assistance from the tutor. For this category it was observed that because they still lacked the skill, even in their attempt to correct these mistakes, they were making new errors and this complicated their response.

Table 4.6: Students competency in Correct a Spelling Error using JAWS

Grading for Test Score	Frequency	Percent
Excellent	4	11.4
Very good	23	65.7
Good	6	17.1
Average	1	2.9
Very poor	1	2.9
Total	**35**	**100.0**

Source: Field Survey, 2014

4.5.3: Students competency in creating a Folder using JAWS

The students' performance on creating a folder using the JAWS application is shown in table 4.7. From the table, it is seen that only one student failed but the majority had amazing performances but with different competencies. For instance, nine students (25.7%) scored excellent. They demonstrated exceptional understanding of the procedure in creating a folder and as a result they were judged as being unconsciously competent. A total of 5 (14.3%) had very good and considered as being consciously competent; 11 (31.4%) had good and judged as being consciously incompetent. While a total of 10

students (28.6%) failed. This was made up of those who had average or credit; poor or weak; and very poor or fail. For them they still lack a mastery of the procedure and need much guidance. That aside, a number of the students in this category confused the procedure of creating a folder for something else, therefore, they were considered not having progressed from the unconscious incompetence stage of the matrix.

Table 4.7: Students 'competency in Creating Folder using JAWS

Grading for Test Score	Frequency	Percent
Excellent	9	25.7
Very good	5	14.3
Good	11	31.4
Average	4	11.4
Poor	3	8.6
Very poor	3	8.6
Total	**35**	**100.0**

Field survey, 2014

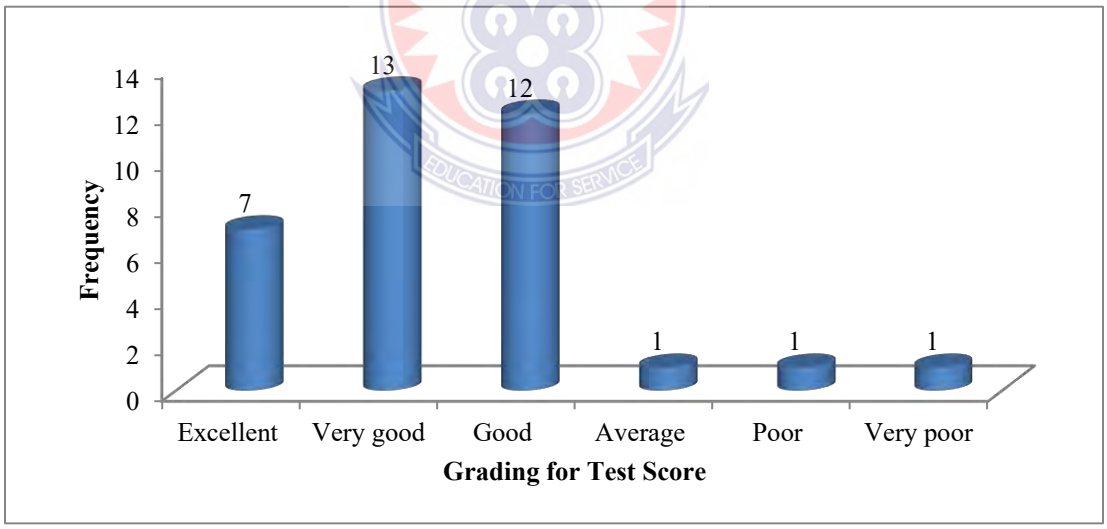
4.5.4 Students' competency in Deleting Characters, Words or Sentences using JAWS

The students were examined on how to delete a character, a word or the entire sentence "***The quick brown fox jumps over the lazy dog***" which they had constructed to determine their speed and accuracy in keyboarding. Figure 4.3 shows that only 7 students (20%) had reached the unconscious competence stage in using JAWS and this is because they could excellently use both the "delete key" and "backspace key" to delete a character, a word or the whole sentence. This category of students were familiar with both the left and right procedure of deleting which corresponded respectively with the use

of the backspace and delete keys. A total of 13 students (37.1%) scored very good and this referred to those who knew how to use only one of either the backspace key or delete key. As a result of this, they were categorized as being consciously competent.

In addition, 12 students (34.3%) scored good and this category of students demonstrated a lower level knowledge as compared with those who scored very good. As a result, they were considered as being within the conscious incompetence stage. The remaining three students who scored from average to very poor were aware of the possibility of deleting a character, a word or a paragraph on a Microsoft Word document but they could not demonstrate hence they were placed under the unconscious incompetence stage.

Figure 4.3: Students' competency in Deleting a Character, Word or Sentence using JAWS



Field survey, 2014

4.5.5 Students' competency in Printing Word Document using JAWS

The JAWS offers visually impaired students the opportunity to navigate different parts of a document or website through the use of shortcuts. Directly in line with this, the

students were examined on their ability to use JAWS to print hard copies of a word document. Figure 4.4 shows that, one student (2.9%) could execute this task excellently using the shortcut "Ctrl + P" to print the word document that had been typed. This student demonstrated great knowledge of the procedure and this was seen in his ability to help other colleagues with this skill, therefore was judged as being unconsciously competent. A total of 14 students (40%) could use the shortcut to print the document but because they were not capable of demonstrates for their colleagues, they were considered as being consciously competent. Thirteen (37.1%) students scored good and had knowledge of the procedure but needed some assistance for them to be able to print the document, as a result, they were considered as being in the conscious incompetence stage. Seven (20%) students were still within stage one of the conscious competence matrix. They averagely and poorly followed the procedure to print a word document.

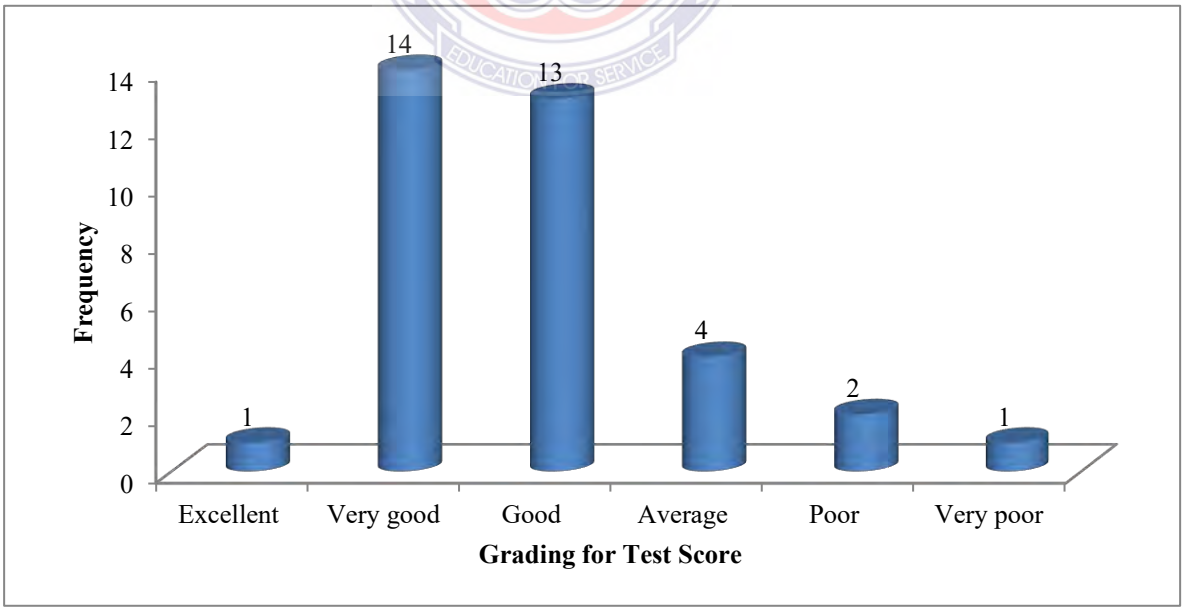


Figure 4.4: Students 'competency in Printing Word Document using JAWS

Field survey, 2014

4.5.6 Students' competency in Saving Changes on Word Document using JAWS

Students were tested on how to save changes to a word document. From table 4.8, 5 students (14.3%) scored excellent knew how to save a word document using the "Ctrl + S" shortcut and they also could carry out this task with relative ease and to demonstrate for others to learn. Because of this, they were judged as being unconsciously competent. In addition, 17 (48.6%) students scored very good. Though they also performed better their standard was not as high as those who scored excellent. This category was therefore judged being within the conscious competence stage. The last category of 13 students (37.1%) scored good and this was because they could not translate their knowledge of this shortcut to effectively save the changes they made to their word documents. However, because they still needed someone to assist them in this regard, they were seen as still being in stage two-conscious incompetence.

Table 4.8: Students' competency in saving Changes on Word Document using JAWS

Grading for Test Score	Frequency	Percent
Excellent	5	14.3
Very good	17	48.6
Good	13	37.1
Total	**35**	**100**

Field survey, 2014

4.6 Objective 3: Challenges of Computer Assistive Technology Use among Students at Akropong School for the Blind

The third objective of the study sought to identify some of the challenges faced by the students in their use of computer assistive technology. As it has been pointed out earlier, computer assistive technology per this study is viewed in two ways namely, keyboarding skills and the use of JAWS application. As a result of this, the challenges are also grouped under this two-fold dimension of computer assistive technology use at Akropong School for the Blind.

4.6.1 Challenges on Keyboarding Skills

In the first place, it is worth noting that not all the students expressed facing challenges with keyboard use. But the number that did not have challenges were the least, because about 95% indicated their unique challenges in keyboarding. The challenges highlighted have been categorized under five broad issues namely: arrangement of keys on keyboard, spacing between keys, time constraint, remembrance of shortcuts and problem of fine motor skills.

In relation to the first challenge- the arrangement of keys on the keyboard- The students explained that they found it difficult to identify some of the keys on time and this particularly relates with the alphabetic keys. They were impressed with the arrangement of these keys on the keyboard which deviates from their conventional knowledge in the flow of alphabetic count. This is typified in the following expression by one student; *"I have difficulty in identifying the letters on the keyboard because the alphabets do not follow the normal arrangement of A, B, C… X, Y, Z"*(field interview

data collected in 2014) It was found that the emphasis was on the amount of time spent to identify a particular key when using the computer. And this makes them frustrated and limits their desire to learn and use computer.

Directly linked with the arrangement of keys, another challenge was the spacing of keys on the keyboard. Accordingly, the students opined that the location of the keys on the keyboard is so close that this affects their competence in the speed and accuracy of constructing sentences. Whereas it is true that consistent practice and use of the keyboard helps a user to develop familiarity with the spacing between keys, this familiarity has not been fully developed among the respondents. Even though the class has computer lessons twice a week, the students perceived the amount of time spent as being limited. In expressing a viewpoint on this, one student states; *"There is inadequate time for practice and this has affected my typing skills. Therefore I could not type fast and accurately…" "*(field interview data collected in 2014).

Most of the respondents therefore complained that it takes extended practice time for them to develop familiarity with the various keys. Even though, they understood that there was an assigned time to subject periods on the School's timetable, their general impression was that, in order to develop their skills in keyboarding and to maximize computer assistive technology usage, additional practice times beyond the two lessons a week should be arranged.

Another challenge that was raised on keyboarding skills is the difficulty in remembering shortcuts. It is well known that computer usage comes with an added benefit of employing shortcuts to navigate a document or carry out other processes. However, most of the students indicated that they find it difficult to remember most of

these shortcuts. While it is undeniable that remembrance of these shortcuts does not come handy it was found out that the students inability to remember shortcuts is directly linked with their difficulty with arrangement and spacing of keys on keyboards.

Lastly, some respondents also had difficulty of developing motor skills. This is because, they have deformity in their wrists (fine motor skills) and this had affected their finger positioning and ability to navigate swiftly across different parts of the keyboard.

4.6.2 Challenges on the Use of JAWS Application

It was also found that about 95% of the students at Akropong School for the Blind have challenges in using the JAWS software as computer assistive technology. Their concerns are organized broadly into four, namely: difficulty of understanding and following accent, malfunctioning and failure of JAWS application, difficulty in having access to licensed JAWS and ability to adjust to changes with the use of JAWS.

According to Kotian and Shamanna (1999) JAWS is voice-synthesizing software when connected to a computer all information displayed on the computer screen could be made to speak and one could comfortably navigate the screen and also move to any part of the screen and read the contents there. Whereas JAWS enables a visually impaired individual to interact with the computer in the same way a sighted individual would, students at Akropong School for the Blind have difficulty in understanding the accent used in the speech recognition. This is because the speech was too fast and the pronunciation of certain terms and words was perceived by the students to be different from their conventional understanding and this poses a challenge.

It was as well found that, there is always malfunctioning and sometimes sudden failure of the JAWS application as it is being used and the students believed this retards progress in their studies. In expressing this frustration, one of the students indicated, *"At times, the JAWS could stop working while being used hence reducing efficiency"*(field interview data collected in 2014) Upon further interaction, they explained that the type of JAWS that is being used in the school is unlicensed and is thus limited in some of its applications or functions. The students are therefore limited to access other uses of JAWS because they use the "cracked version" coupled with it inefficient functioning.

Another category of the students had the challenge of adjusting from the use of mouse to the use of shortcuts. This challenge was faced by a number of the students who initially had their sight and were familiar with the use of the mouse. But when they later lost their sight and were brought to the school for the blind they still had difficulties adjusting from their knowledge of the use of mouse to memorizing and using shortcut as required by the JAWS application.

4.6.3 Strategies to Address Challenges associated with Computer Assistive Technology Use

From the above discussion, it is clear that there are serious challenges that hinder the competence of student in the use of computer assistive at Akropong School for the Blind. However, these challenges are not being left unaddressed. A number of strategies have been adopted by the ICT teacher in collaboration with the students and their parents and these are highlighted below:

Keyboarding Skills

There were a number of strategies highlighted by the students to address the challenges hindering their competence in keyboarding skills. In the first place, it was found that mental drill is the strategy adopted by the ICT teacher to address the challenge of remembering numerous shortcuts. One respondent explained that, *"... there is ten (10) minutes mental drill conducted by the ICT teacher on keyboard shortcuts and this has helped us to memorize more shortcuts in order to improve our competence" "*(field interview data collected in 2014).

Secondly, to address difficulty of students with the arrangement and spacing of keys on the keyboard the way forward has been in developing their familiarity. And in this regard, one student indicated that, *"The teacher has been encouraging them to have additional computer classes during vacations. He emphasized that when they are able to do that then they can practice more to help themselves develop familiarity with location of the keys on the keyboard"*(field interview data collected in 2014).

Directly linked with the above, another student pointed out that, *"During computer lessons each of us is given the opportunity to show the positioning of various parts of keyboard. And this has helped us to develop familiarity with the positioning of the keys, especially the arrangement of the alphabetic keys"* (field interview data collected in 2014).

For computer use in such educational setting, it is important that there is a standard yet simplified reference material which the students can consult to address these challenges. The students indicated that, a booklet has been prepared by their ICT teacher on the use of JAWS and keyboard. It is worthwhile that the students are happy with this

reference material. One of the students emphasized that, *"this book has simplified directions that give us guidance to addressing not just keyboard and JAWS but any other challenges on computer usage"*(field interview data collected in 2014).

JAWS Application Use

To address the challenge of voice recognition, the students indicated that, their teacher always encourages them to listen carefully to the speech of the JAWS in order to become familiar with the voice. A student said that, *"We are often given ten (10) minutes to listen to the speech and explain our understanding to the teacher and this has helped us to understand the accent"*(field interview data collected in 2014).

Other respondents also expressed that, the teacher has been helping them with some of the pronunciations to have a better understanding of voice recognition in the JAWS application. There is also a mental drill on the JAWS usage and the students stated that in order to get good marks, they have to listen keenly and this has also contributed to enhancing their familiarity with JAWS use.

As it was noted earlier, Akropong School for the Blind has an unlicensed version of JAWs which malfunctions and fails at times. When asked what was being done to address this challenge, one respondent said, *"The Parent-Teacher Association (PTA) and benevolent individuals and philanthropists have been encouraged to help the school obtain licensed JAWS for the computer laboratory" "*(field interview data collected in 2014). Just as it was pointed out under the keyboarding skills that students should have adopted computer lesson during vacation, it has been encouraged that parents who could try the licensed version of JAWS for their children at home so that they can practice

during vacations. But most of the students believed this is not quite feasible. Their explanation was that, “If the school under governmental support cannot purchase licensed JAWS for their use in school, then it means that most of our parents cannot” (Field interview, 2014).

4.7 Chapter Summary

In terms of the first objective, the findings have shown that, fingers positioning on the keyboard and the ability to identify the difference between alphabetic and numeric keys is not a huge challenge for the students. As a result, 80% to 83% of the students have reached the unconscious competence stages. However, in terms of speed and accuracy of typing the sentence, the findings show that 49% of the students are still within the unconscious incompetence stage in typing a sentence.

In relation to the second objective, majority (83%) of the students, were highly competent in launching Microsoft word using JAWS because they have built familiarity in this area. About 65.7% of the student had reached the conscious competence stage using shortcuts to navigate and make corrections on a word document. However, 95% of the students expressed that, the inability to remember most of the shortcuts and this is a limiting factor for them to become unconsciously competent.

In terms of keyboarding skills, the challenges included; arrangement of keys on keyboard, spacing between keys, time constraint, remembrance of shortcuts, and problem of fine motor skills. The concerns on JAWS included; difficulty of understanding and following accent; malfunctioning and failure of JAWS application; ability to adjust to changes.

CHAPTER FIVE

DISCUSSION OF RESEARCH FINDINGS

5.0 Introduction

This chapter discusses the results in the light of the literature review and the research questions raised.

5.1 Overview of Computer Assistive Technology at Akropong School for the Blind

The teaching and learning of ICT particularly computer usage is core to the curriculum at the Akropong School for the Blind. While this might be in response to the revised provisions in recent years by the Ghana Education Service (GES) to incorporate the teaching and learning of Information and Communication Technology (ICT) into the educational curriculum, the use of computer assistive technology in the School far exceeds meeting this requirement.

The literature reviewed pointed to the fact that assistive technology devices usage is essential for students with visual impairment. There is an evidence which shows that the use of assistive technology devices have a positive impact on these students' lives through motivation to study (Cooper & Nichols) and this has also helped to develop positive relationships in their academic achievement.

During my interaction with the students it was found out that, the blind students depended on sighted guides which in most cases are hard to come by. Even if a student is privileged to have a sighted guide, a major challenge is the inability of the guide to offer precise assistance in personal learning activities. In the light of such challenges, the adoption of computer assistive technology has contributed to reducing the stress and over

dependence on sighted guides to assist the visually impaired students in the school. This argument is made formidable because, scholars have found out that as students develop their competence in the use of computer assistive technology devices, the resulted impact on learning include increasing reading speed and comprehension rate (Corn et al., 2002; Kennedy, 2000). Gamble and Hirsch (2003) also posit that students' dependence on computer assistive technology skills for learning helps in developing their reading and writing skills.

It must however be emphasized that it is not just about adopting and using these assistive devices, but rather helping the students to acquire the necessary competencies. This is necessary because an early study by Kapperman et al., (2002) has shown that 60% of students with visual impairments were not benefitting from computer assistive technology as a result of lack of the needed competencies for using these technologies.

5.2 Objective 1: To assess students' competency in the usage of keyboard at Akropong School for the Blind.

There is the need to develop the keyboarding skills for visually impaired students because it impacts in the learning abilities. This is because when students have the skills to exercise control over their environment, it leads to greater independence, increases self-sufficiency and enhances self-esteem (Kapperman et al). In this current study, keyboarding skills were measured in three areas and these include (i) finger positioning on the keyboard, (ii) the ability to identify the alphabetic and numeric keys and (iii) the speed and accuracy of typing.

Based on the performance rating (as shown in Table 4.4, Figure 4.1), it is obvious that fingers positioning on the keyboard and the ability to identify the difference between alphabetic and numeric keys is not a challenge among the students in Akropong School for the Blind. This is because in both cases the students recorded a 100% pass in line with the grading system; the minimum score was average or credit (50% - 59%). In addition, the study found out that cumulatively 80% and 83% of the students scored excellent to very good respectively on finger positioning and identifying alphabetic and numeric keys on the keyboard. This means that, most of the students are responsive to training and practices in the use of computer assistive technology which is part of their curriculum.

Whereas the number of students within the unconscious incompetence stage in relation to finger positioning is less, it is necessary to give special attention to these few students to help them progress through the stages of competence as described in the matrix. The varied performance also typifies the need not to presume that all students have learned basic computer use skill like finger positioning, hence, there is the need for revised training and regular checkup on student with deficiency in this regard.

The finding on the speed and accuracy of typing the sentence indicated that majority of the student performed poorly. This is probably because about 49% of the class is still within the unconscious incompetence stage in typing a sentence. The Conscious Competence Matrix explains that people in this stage have a particular deficiency in the area concerned. It was particularly found that 25.7% of the students failed to accurately type the simple sentence. This is a matter of grave concern because all the students acknowledged were introduced to computer lessons since class one and currently twice a week and it was expected that they should have moved out of the

unconscious incompetence stage of the Matrix. It was clear that the amount of time spent develop the competence of students in the typing was the same, yet a number of them are still unconscious of the need for this skill. Hence their performance has retrogressed from 17.1% to 11.4% as shown in table 4.5.

It could be concluded that the students at Akropong School for the Blind were probably not serious with the training being offered them to develop their competence in speed and accuracy in sentence construction. But in order to validate such a generalization, it is crucial to consider the effectiveness of training being offered to the students in the School. Secondly, a related factor is how consistent and practical the computer lessons are taught in the weekly schedules. However, this study is limited in its focus on examining the competence of ICT trainers and how this could translate in students' competence in sentence construction. Thus, it is recommended further research should be carried out on competency of teachers in teaching computer assistive technology.

Evaluating the student competence in line with the conscious competence matrix adopted for this study, it is obvious that majority of the students had reached the conscious competence stage in relation to finger positioning and ability to identify alphabetic and numeric keys on keyboard. The students achieve 'conscious competence' in a skill because they performed it reliably at and will need to concentrate and think in order to perform that skill. But characteristically, their competence level could be seen as not yet 'second nature' or 'automatic'. That is, they are able to demonstrate the skill to others, but are unlikely to be able to teach it well to another person.

On the issue of speed and accuracy in sentence construction, the competence level could be judged as conscious incompetence. That is, they understand that improving their skills or abilities in this area would make them effective. Therefore with commitment to learning and working to address the challenges affecting students' keyboarding skills, majority of the students could move to the 'unconscious competence' stage.

Objective 2: To determine how students use Job Access with Speech (JAWS) to search basic information from computer at Akropong School for the Blind

It is evident from figure 4.2 that there is a higher response rate of 83% in the timely launching of Microsoft Word using JAWS and this possibly shows that they had built familiarity in this area. Even though the students demonstrated their ability to launch Microsoft Word, it must be stated that the ability to maximize working on a word document links one's competencies on keyboarding skills and the ability to use the shortcuts to execute other tasks while working on Microsoft Word.

The JAWS provides added benefit of using shortcuts that allow the visually-impaired to navigate a document with ease. It was found that 65.7% of the students scored very good in being able to correct their errors on a word document as shown in table 4.7. As a result majority of the students have become competent in using the shortcuts to navigate and make corrections to working document in Microsoft Word. But because they are located within the conscious competence stage, continuous training and commitment on the part of students to learn more about computer application shortcuts is required. It is also important to mention that a number of the students expressed as a

challenge, their inability to remember most of the shortcuts. This could be enhanced through continual practice and use of computer.

In terms of the ability to create a folder using JAWS 40% (this includes those who scored very good and excellent) of the class progressed from stage one to stages three and four of the conscious competence matrix while the remaining 60% could not. Generally the incompetence of this 60% was seen as a great challenge. This is because creating a folder is seen to be one of the basic steps for beginners in computer usage. And, if at JHS Two, about 60% of the students still lack the basic skill such as creating a folder, then it is worth questioning how effective and when would such visually impaired students make progress in learning higher skills in computer use and to compete with their sighted colleagues.

The reasons for the failure of some of the students in being able to create a folder is associated with their non- familiarity with the JAWS application and other additional challenges (discussed under the objective 3). That notwithstanding, there is the need for the instructors and trainers to review lessons on introduction to computer. This would help to refresh the minds of those in stage two to progress to the third and fourth stages. It would also provide those still within stage one, who by participating in this study have become aware of their deficiency to also begin with the desire to learn the new skill of using JAWS to create folders.

From figure 4.3, it was found that cumulatively, 91.4% of the students were competent in being able to delete a character, a word and the entire sentence. These students exhibited their competence in being able to navigate between the back and forward deleting process in the use of the backspace key and delete key respectively. But

because majority of the students are in stages two and three of the conscious competence, when they are given further guidance and they are ready to commit themselves to learning, they could easily progress to the fourth stage. The need for guidance is also required to develop students' competence in printing a hard copy of a word document.

In addition, a higher number of the students are still in stage two of the conscious competence matrix in relation to their ability to save changes to a word document, there is higher risk of possibly losing content in the event of interrupted shut down due to power outages. This is because the computer laboratory at the Akropong School for the Blind had only desktop computers and because these depend on direct power supply. Thus, the need to enhance students' competence in being able to save changes made on a word document is necessary.

Objective 3: To identify the challenges associated with computer assistive technology use among students at Akropong School for the Blind

There are numerous benefits of computer assistive technology among students with visual impairment. It is particularly noted that through the use of these devices, students with visual impairment gain independence and autonomy concerning information management and access to communication, just like their peers with normal vision (Caparos, 1994). That notwithstanding, a number of barriers exist to the successful and effective use of assistive technology devices among people with various disabilities in schools. This is evident in the fact that 95% of the students at Akropong School for the Blind highlighted various challenges which hamper their competencies in keyboarding and JAWS application use.

However, the results of the study show that, the challenges mentioned by the students are related to personal response to computer assistive technology use rather than external influence. These challenges arise due to the individual response to the training and familiarity by the students in developing their competencies in using computer assistive technology. This however excludes the malfunctioning and failure of JAWS application. This very challenge has external influence and its manifestation is linked with limited financial resources, high costs of equipment and eligibility issues for possessing devices (Fifield & Fifield, 1997; Wehmeyer, 1998; Zhang, 2000).

While a lack of knowledge and support from teachers (Alper & Raharinirina) has been seen as a barrier for computer assistive technology among visually impaired students, the case of the students at Akropong School for the Blind is different. This is because the various strategies that the students highlighted as being used to address their challenges demonstrate knowledge and support from their ICT teacher.

In another study, Johnson (2011) indicated that a lack of knowledge and awareness among people with visual impairment, reluctance to use the devices, poor device performance, changes in needs or priorities, and feelings of stigmatization are major reasons for underused assistive technology devices. The findings of the study have shown that, the students at Akropong School for the Blind have developed knowledge of the need to use computer assistive technology.

The study results also seem to suggest that there are strategies that are being adopted by the ICT teacher at Akropong School for the Blind to address these challenges are robust and sustainable to develop students' familiarity on keyboarding. This possibly accounts for the fact that, a higher percentage of the students had reached stages three and

four of the competence matrix. The students' competence in using computer assistive technology has been affected by the malfunctioning and sometimes failure of JAWS.

5.3 Chapter Summary

Evaluating the student competence in line with the conscious competence matrix adopted for this study, it is obvious that majority of the students have reached the conscious competence stage in relation to finger positioning and ability to identify alphabetic and numeric keys on keyboard. The students achieve 'conscious competence' in a skill because they performed it reliably at and will need to concentrate and think in order to perform that skill. The JAWS provides added benefit of using shortcuts that allow the visually-impaired to navigate a document with ease. Majority of the students have become competent in using the shortcuts to navigate and make corrections while working on a document in Microsoft Word. But because they are located within the conscious competence stage, continuous training and commitment on the part of students to learn more about computer application shortcuts is required. The study showed that, the challenges mentioned by the students are related to personal response to computer assistive technology use rather than external influence. That is these challenges arised due to the individual response to the training and familiarity by the students in developing their competencies in using computer assistive technology.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the summary gives a summary, conclusion, and the recommendations made based on the findings.

6.1 Summary

The purpose of this study was to assess student's competency in the use of computer assistive technology at Akropong School for the Blind. Thirty-five blind students were purposively sampled from a population of 105 students. Data were gathered through a self-design computer competency test and an in-depth interview guide.The data generated from the practical computer competency test was entered into the Statistical Package for Social Sciences (SPSS, version 16) for analysis. Findings were presented using the descriptive statistical tools of frequency tables and charts. The transcribed data from interviews were analyzed thematically. That is the key themes were identified in the conversations and these were drawn and discussed. This was done using both the narrative methods and opened quotes from interviews.

The research was conducted among JHS Two students at Akropong School for the Blind in Ghana. It was found out that majority of the students (46%) are between the ages of 12 and 16 years. On gender, the male population was twice (66%) the population of their female counterparts (34%).

In terms of computer assistive technology use, the school has a computer laboratory furnished with 31 working desktop computers. The students have two lessons

(35 minute per lesson) in a week and these are carried out on Tuesday and Thursday. Furthermore, the computers' keyboards are of the "QWERTY" standard.

The findings show that, fingers positioning on the keyboard and the ability to identify the difference between alphabetic and numeric keys is not a huge challenge for the students. This is because majority (80% and 83%) had higher competencies on finger positioning and identifying alphabetic and numeric keys on keyboard. However, in terms of speed and accuracy of typing the sentence, the finding show that 49% of the students are still within the unconscious incompetence stage in typing a sentence. That is these students are deficient in accurately typing a sentence. Despite the fact that the same amount of time has been spent develop the competence of students in the typing; these are still unconscious of the need for this skill hence they performed poorly. Majority of the students, 83% are highly competent in launching Microsoft word using JAWS and this possibly shows that, they have built familiarity in this area. This finding was supported by the fact that, 65.7% of the student had reached the conscious competence stage using shortcuts to navigate and make corrections on a word document. However, 95% of the students expressed that, the inability to remember most of the shortcuts is a factor that limits them from becoming unconsciously competent.

Students' competencies in using JAWS to create a folder are poor because 60% are still within the incompetence stages of the conscious competence matrix. But in terms of being able to delete a character, a word, and the entire sentence using the backspace and delete keys, cumulatively 91.4% had progressed to stages two and three of the conscious competence matrix. The number of students with higher competence in being able to print hard copy of a word document and to save changes was extremely low.

The use of computer assistive technology among the students at Akropong School for Blind is not without challenges because 95% of the class expressed various difficulties in developing their competence in keyboarding skills and JAWS application use. In terms of keyboarding skills, the challenges included; arrangement of keys on keyboard, spacing between keys, time constraint, remembrance of shortcuts, and problem of motor skills. The concerns on JAWS included; difficulty of understanding and following accent; malfunctioning and failure of JAWS application; ability to adjust to changes.

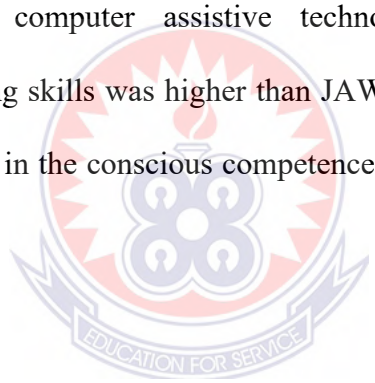
The findings suggest that, there are strategies being adopted by the ICT teacher in the school to address these challenges. These strategies are robust and sustainable to develop students' familiarity on keyboarding. While the same can be said about the JAWS application use, it was found that the malfunctioning and failure of the JAWS can limit such efforts.

6.2 Conclusion

The purpose of this study was to assess students' competence in the usage of computer assistive technology at Akropong School for the Blind. To achieve the objectives, two dimensions of computer assistive technology namely keyboarding skills and Job Access with Speech (JAWS) were examined. Students' competence was measured by their progress from the incompetence stages (stage 1 and 2) to the competence stages. Majority of the students had higher competencies on finger positioning and identifying alphabetic and numeric keys on keyboard, thus in relation to these skills they were unconsciously and conscious competent. In terms of speed and

accuracy of typing the sentence, majority of the students were either conscious or unconscious incompetent.

Students had higher competencies in launching Microsoft word, correct spelling and to delete a character, a word, and the entire sentence using JAWS. While lower competencies were measured in relation to creating folders, printing hardcopy and saving changes on a word document using JAWS. The data showed that challenges limiting effective of students' competence in computer assistive technology use in the School are more personal than external influence. This was because most of the challenges are probably due to the individual response to the training and familiarity in developing their competencies in using computer assistive technology. Comparatively students' competence in keyboarding skills was higher than JAWS application use. Thus, students had reached higher stages in the conscious competence matrix in keyboarding skills than JAWS.



6.3 Recommendations

The following recommendations are made based on the study findings.

1. The total number of 31 computers in the laboratory was less than the class size of 35 students. The shortage meant that some students had to share the same computer and this limits their learning skills. It is therefore recommended that, efforts should be made to stock up the laboratory with additional computers.
2. Directly in line with the first recommendation, it is further suggested that more practice time should be created for the students to maximize and improve students

keyboarding skills. This will helps the students to have ample time to develop their competencies in typing sentences and other challenges on JAWS use.

3. A number of the challenges expressed by the students on their non- familiarity with the JAWS. As a result, it is recommended that instructors and trainers at the school should engage the students in revised lessons on introduction to computer. This will help to refresh the minds of those in stage two to progress to the third and fourth stages. It will also provide those still within stage one to begin to desire to learn the new skill of using JAWS.
4. JAWS must be acquired by the school to advance students' competence in using computer assistive technology.
5. It is further suggested that robust and sustainable strategies should be adopted by the management of the school to develop students' familiarity on keyboarding and JAWS and should be encouraged.

6.4 Suggestions for further research

1. Designing local voice recognition software for persons with visual impairment.
2. Evaluating teacher's competency in the use of computer assistive technology and how it affects the student's academic performance.

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Appendix I

DEPARTMENT OF SPECIAL EDUCATION

UNIVERSITY OF EDUCATION, WINNEBA (UEW)

April 4, 2015

Dear Sir/Madam,

LETTER OF INTRODUCTION

I write to introduce to you Joseph Ampratwum – an M. Phil student at the Department of Special Education of the University of Education, Winneba.

He is currently working on his thesis: **Students' competency in the use of computer assistive technology at Akropong School for the Blind.**

He would need your assistance to collect data from your school. I would therefore, be grateful if you could provide him with the necessary assistance.

Thank you for time and cooperation.

Yours faithfully,

SAMUEL HAYFORD (PHD)

HEAD DEPARTMENTOF SPECIAL EDUCATION

Appendix II

UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SPECIAL EDUCATION

This questionnaire is purposely designed for **students** to provide data on the topic the "**Students Competency in the Use of Computer Assistive Technology at Akropong School for the Blind**". This thesis is submitted to the Department of Special Education, University of Education, Winneba in partial fulfillment of the requirement for the award of MPhil Degree in Assessment in Special Education. Therefore, any information that is provided would be treated confidentially and wholly for the academic pursuit.

The study adopted the grading system used by the Ghana Education Service for the Basic Education Certificate Examination to ensure that, the research findings are reliable and that, the conclusions drawn are valid. This will provide the basis to determine the competence of the students in relation to keyboarding skills and JAWS. The grading system is illustrated in table

Table 4.1: Adopted GES Grading System for BECE

Qualification	Marks obtained
Excellent	80 % and above
Very good	70% - 79%
Good	60% - 69%
Credit or Average	50% - 59%
Weak or Poor	45% - 49%
Fail or Very poor	39% and below

Name of Interviewer: …….
(Compulsory)
Date: …….

Signature……..

INSTRUCTION: Please either **tick (√)** where applicable.

Demographic Characteristics of Student

1. Gender Male ☐ Female ☐

2. Age Below 12 ☐ 12 – 16 years ☐ 16years and above ☐

Objective 1: Students' Competence in Keyboarding Skills at Akropong School for the Blind

Finger Positioning

4. How do you assess the student's fingers positioning on the keyboard?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

5. How do you assess the student's ability to identify different between alphabetic and numeric keys on the keyboard?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

6. How do you assess the student's speed and accuracy in typing the following short sentence "***The quick brown fox jumps over the lazy dog***"?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

Objective 2: Students' Competence in Using Job Access with Speech (JAWS) at Akropong School for the Blind

7. What is the assessment of the student in being able to launch Microsoft office word from the desktop environment with the use of Job Access With speech?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

8. What is the assessment of the student in being able to correct a spelling error using the Job Access with Speech?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

9. How do you assess the student's ability to demonstrating how to create a folder with the use of Job Access with Speech?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

10. How do you assess the student's ability in using Job Access with Speech to delete a character, a word, sentence or paragraph on a Microsoft word documents?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

11. What is the assessment of the student in being able to print text as hardcopy or hard document with the use of Job Access with Speech?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

12. What is the assessment of the student's ability to save changes effected in a sentence with the use of Job Access with Speech?

a. Excellent ☐ b. Very Good ☐ c. Good ☐ d. Average ☐ d. Poor ☐ d. Very Poor ☐

Appendix III

UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SPECIAL EDUCATION

INTERVIEW GUIDE

This interview guide is purposely designed for **students** to provide data on the topic the "**Students Competency in the Use of Computer Assistive Technology at Akropong School for the Blind**". This thesis is submitted to the Department of Special Education, University of Education, Winneba in partial fulfillment of the requirement for the award of MPhil Degree in Assessment in Special Education. Therefore, any information that is provided would be treated confidentially and wholly for the academic pursuit

Objective 3: Challenges of Computer Assistive Technology Use among Students at Akropong School for the Blind

1. Which year were you introduced to the use of computer assistive technology?
2. What was your stage when you were introduced into to computer assistive technology?
3. How many times in a week do you attend computer classes?
4. What is the duration of each computer lesson?
5. How many computers do you have in the school?
6. How do you assess the state of these computers?
7. What challenges do you face in developing your keyboarding skills?
8. What challenges do you face with the use of the Job Access with Speech?
9. What is currently being done to address these challenges?

Name of Interviewer: ……. *(Compulsory)*
Date: ……..

Signature……..